TRANSISTORS

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FIELD EFFECT
POWER

FIRST WITH THE LATEST IN INDUSTRIAL ELECTRONICS

Pioneer/Columbus

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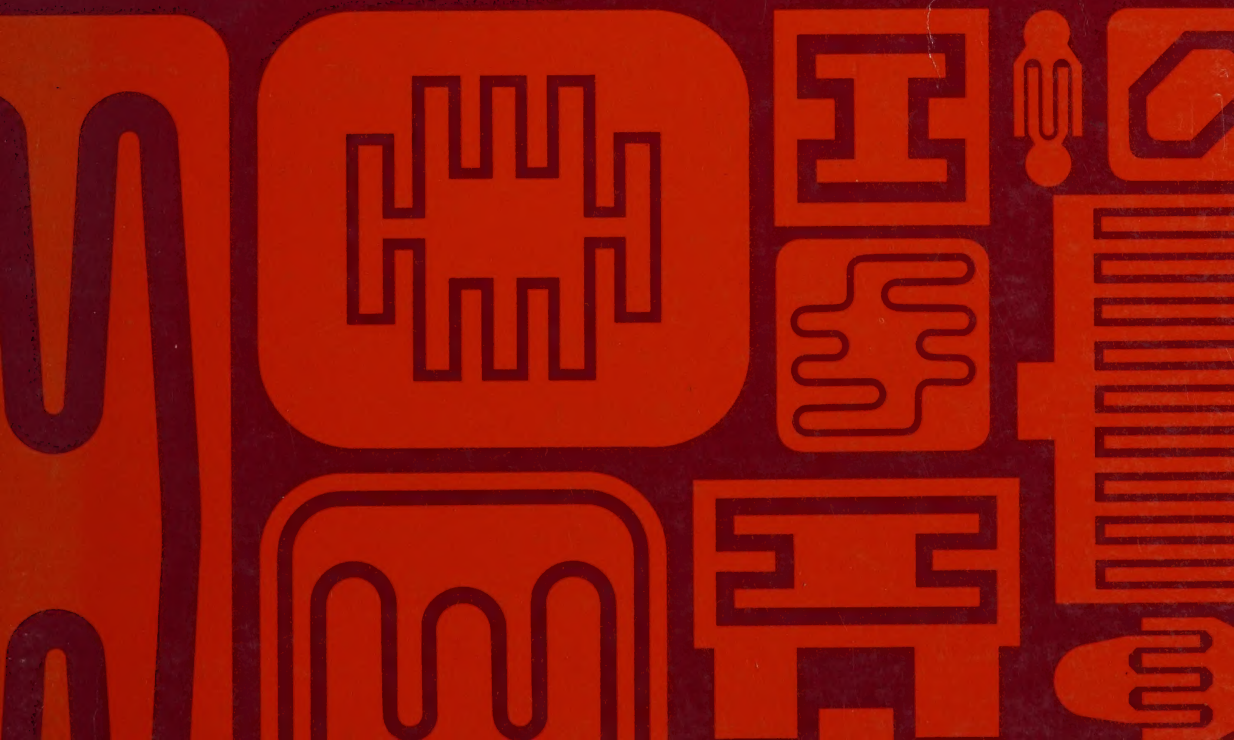
National



Introduction

This is National Semiconductor's latest handbook on discrete semiconductor devices. You will notice that the company has added many new transistor part numbers and product families since publication of the last handbook in 1973. Many of these new products already have been widely acclaimed by users.

In addition to small signal and bipolar field effect transistors that have been the mainstay of our catalog, are sections for multiple bipolar, multiple field effect and power transistors. More part numbers will be added as market needs expand.

To keep current on all new National transistors please contact your National sales representative or franchised distributor and ask to be placed on the customer mailing list.

HOW TO USE THIS CATALOG

Find the basic transistor *Type Number* in the Standard Parts Listing which begins on page vi. This will reference a page number for the particular Specification sheet.

The *Process Number* (or chip type) for the device will be found in the extreme right-hand column of the Specification sheet. Process Characteristic sheets are arranged in numerical order and that section begins on page 84.

Refer to the *Package Outlines* beginning on page 261 for complete physical dimensions of all packages. Note that the numbers in parenthesis behind the case style numbers refer to NS internal package codes.

Process Characteristic sheets contain complete design/application data and limit information. Critical package parameters will be indicated in the "Notes" column of the Process Characteristic sheets.

The *Table of Contents* shows the transistor type number and process number sections organized by general application.

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40319	42
40321	27
40472	6
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40479	7
40480	7
40481	7
40482	7
AM1000	230
AM1001	230
AM1002	230
BC107	58
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BC108B	58
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BFX88	72
BFY39	72
BFY39-1	72
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BSX21	72
BSX45-6	72
BSX45-10	72
BSX45-16	72
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BSX46-10	72
BSX46-16	72
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BSY39	73
BSY51	73
BSY52	73
BSY53	73
BSY54	73
BSY95A	73
CS9010	7
CS9011	7
CS9012	42
CS9013	23
CS9016	7
CS9017	7
CS9018	7
CS9019	7
DH3467CD	75
DH3467CN	75
DH3725CD	78
DH3725CN	78
DH6376CD	81
DH6376CN	81
E100	53
E101	53
E102	53
E103	53
E109	48
E300	49
E308	49
E309	49
E310	49
E311	49
E312	49
EN697	18
EN706	4
EN708	4
EN722	40
EN744	4
EN916	18
EN918	7
EN930	11
EN956	18
EN1132	40
EN1711	18

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EN2219	18
EN2222	18
EN2369A	4
EN2484	11
EN2905	40
EN2907	40
EN3250	40
EN3502	40
EN3504	40
FM1100A	56
FM1101A	56
FM1102A	56
FM1103A	56
FM1104A	56
FM1105A	56
FM1106A	56
FM1107A	56
FM1108A	56
FM1109A	56
FM1110A	56
FM1111A	56
IMF6485	55
ITE4391	48
ITE4392	48
ITE4349	48
KE510	48
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KE3684	53
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KE4220	53
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MPF110	53
MPF111	53
MPF112	53
MPSA05	23
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MPSA09	11
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MPSA12	23
MPSA13	23
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MPSA20	18
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MPSA43	27
MPSA55	42
MPSA56	43
MPSA70	34
MPS706	4
MPS834	4
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MPS2712	18
MPS2713	4
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MPSH30	8
MPSH31	8
MPSH32	8
MPSH37	8
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NSD132	28
NSD133	28
NSD134	28
NSD135	28
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PE5055	8
PF510	57
PM918	8
PN930	11
PN2221	19
PN2221A	19
PN2222	19
PN2222A	19
PN2369	4
PN2369A	4
PN2484	11
PN2906	41
PN2906A	41
PN2907	41
PN2907A	41
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SE1002	8
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SE3001	8
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SE4001	11
SE4002	11
SE4010	11
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SE5024	8
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TIS73	48
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TIS88	50
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U233	54
U234	54
U235	54
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U280	54
U281	54
U282	54
U308	50
U309	50
U310	50
U312	50
U1897E	49
U1898E	49
U1899E	49
U1994E	50
UC241	50
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UC450	58
UC451	58, 57
UC714	53
UC734	50
UC734E	47, 50

MIL-STD Qualifications

MIL-STD-19500 qualifications

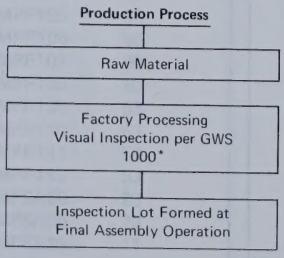
Type	Detail Spec.	Qualification JAN	TX	TXV	File or Approval No.	Date of Approval	Approving Agency	Part Included on MIL-STD 701
2N706		X						
2N760A	218	X			19500 1069 68	3/4/69	DESC	X
2N918	301	X	X	X	19500 1162 67	2/21/68	DESC	X
2N929	253	X	X	X	6724	4/9/65	DESC	
2N930	253	X	X	X	6725	4/9/65	DESC	X
2N2218	251	X	X	X	6935	10/6/67	DESC	X
2N2218A	251	X	X	X	6921	10/6/67	DESC	X
2N2219	251	X	X	X	6936	10/6/67	DESC	X
2N2219A	251	X	X	X	6922	10/6/67	DESC	X
2N2221	255	X	X	X	6937	10/9/67	DESC	X
2N2221A	255	X	X	X	6923	10/9/67	DESC	X
2N2222	255	X	X	X	6938	10/9/67	DESC	X
2N2222A	255	X	X	X	6924	10/9/67	DESC	X
2N2369A	317	X	X	X	19500 161 68	4/25/68	DESC	X
2N2604	354	X			7066	10/27/66	AMSES	X
2N2605	354	X	X	X	7067	10/27/66	AMSES	X
2N2904	290	X	X	X	6939	10/17/67	DESC	X
2N2904A	290	X	X	X	6940	10/17/67	DESC	X
2N2905	290	X	X	X	6941	10/17/67	DESC	X
2N2905A	290	X	X	X	6942	10/17/67	DESC	X
2N2906	291	X	X	X	6943	10/17/67	DESC	X
2N2906A	291	X	X	X	6944	10/17/67	DESC	X
2N2907	291	X	X	X	6945	10/17/67	DESC	X
2N2907A	291	X	X	X	2946	10/17/67	DESC	X
2N2920	355	X	X	X	7124	1/5/67	DESC	X
2N3019	391	X	X	X	19500 356 68	5/19/69	DESC	X
2N3250A	323A	X	X	X	19500 1204 69	6/19/70	DESC	
2N3251A	323A	X	X	X	19500 1204 69	6/19/70	DESC	
2N3810	366	X	X	X	19500 1065 68	5/28/69	DESC	X
2N3811	366	X	X	X	19500 1065 68	5/28/69	DESC	X

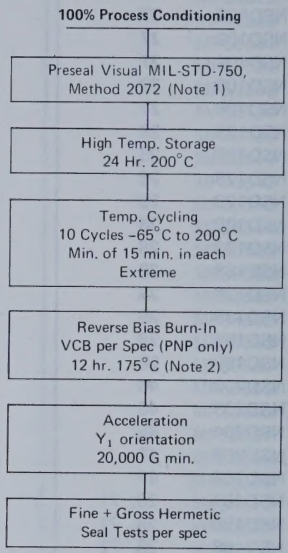
JAN TX, TXV, NX and NXV processing

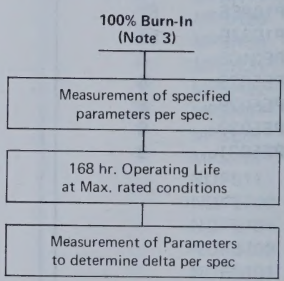
The 100% reliability pre-conditioning on JAN TX parts (vs. no pre-conditioning of JAN parts) has resulted in a significant improvement in field reported failure rates.

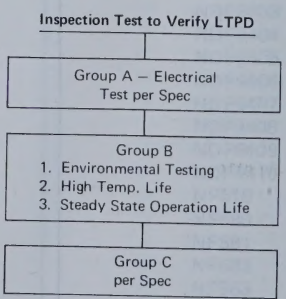
National Semiconductor also offers JAN TXV types (JAN TX with 100% preseal visual inspection per MIL-STD-750 Method 2072) per the above list.

All hermetically sealed transistors in this catalog (where JAN TX or JAN TXV specifications do not exist) are available with TX and TXV type 100% processing as NX and NXV types respectively; e.g., NX2N4033 is 2N4033 processed per the flow plans on this page.









*Patterned after Visual Criteria of MIL-STD-883.

Note 1: JAN TXV types only.

Note 2: Reverse Bias Burn-in restricted to PNP devices only on current JAN TX specs.

Note 3: JAN TX and JAN TXV types only.

Bipolar Transistor and FET Dice

DICE

Standard types from National's transistor families are available in unencapsulated die form for use in hybrid circuits.

FEATURES

- 100% probed and guaranteed to 10% LTPD for key 2N parameters.
  a. BV_{CBO}, BV_{CEO}, BV_{EBO} and h_{FE} for bipolar transistors.
  b. BV_{GSS}, I_{DSS}, I_{GSS}*, R_{ON}*, Y_{fs}, $V_{GS(off)}$ for FET's.
- Minimum 60% yield to all unprobed 2N parameters.
- 100% visual inspection guaranteed to 10% LTPD for criteria equivalent to MIL-STD-883 Method 2010.
- Gold backing on all types.
- Shipment in waffle carriers.
- Die geometries shown in process section of catalog. Base Pad is identified by adjacent metalized circle on all interdigitated geometries. (e.g. see Process 21)

STANDARD TYPES (see index for page listing specification)

BIPOLAR TRANSISTOR DICE		FETs	
2N915	2N3250A	2N2608	2N4341
2N918	2N3251	2N2609	2N4391
2N929	2N3251A	2N3684	2N4392
2N930	2N3467	2N3685	2N4393
2N2219, 2222	2N3468	2N3686	2N4416
2N2219A, 2222A	2N3564	2N3687	2N4416A
2N2218, 2221	2N3565	2N3821	2N4856
2N2218A, 2221A	2N3568	2N3822	2N4857
2N2369A	2N3569	2N3823	2N4858
2N2484	2N3638A	2N3824	2N5114
2N2605	2N3640	2N3954	2N5115
2N2880	2N3646	2N3955	2N5116
2N2890	2N3694	2N3956	2N5163
2N2891	2N3724	2N3957	2N5196
2N2894	2N3725	2N3958	2N5197
2N2894A	2N3903	2N4091	2N5198
2N2904, 2906	2N3904	2N4092	2N5199
2N2904A, 2906A	2N3905	2N4093	2N5432
2N2905, 2N2907	2N3906	2N4117	2N5433
2N2905A, 2907A	2N4030	2N4118	2N5434
2N3014	2N4033	2N4119	2N5518
2N3019	2N4208	2N4338	2N5566
2N3020	2N4209	2N4339	2N5912
2N3250		2N4340	U310

Information on alternative specifications and packaging methods available on request.

***FET NOTE:**

Leakages (I_{GSS})	≤100PA	10% AQL
$RDS_{(ON)}$	≤10Ω	10% AQL

Bipolar Transistor Equivalents List

METAL P/N	PLASTIC EQUIVALENT	ELECTRICAL EQUIVALENCY*	PROCESS
2N697	2N4400	A	13
2N706	MPS706	E	21
2N708	MPS3646	N	22
2N718	2N4400	A	13
2N722	PN2906	N	63
2N744	PN2369	N	21
2N753	PN2369	N	21
2N760A	2N4409	N	07
2N834	MPS834	E	21
2N869A	MPS3640	A	65
2N915	MPS6565	A	27
2N917	MPS3563	E	43
2N918	PN918	E	43
2N929	2N4409	N	07
2N930	PN930	E	07
2N956	PN2222A	N	19
2N995A	MPS3640	A	65
2N1132	PN2906	N	63
2N1613	PN2221A	N	19
2N1711	PN2222A	N	19
2N2218	PN2221	E	19
2N2218A	PN2221A	E	19
2N2219	PN2222	E	19
2N2219A	PN2222A	E	19
2N2221	PN2221	E	19
2N2221A	PN2221A	E	19
2N2222	PN2222	E	19
2N2222A	PN2222A	E	19
2N2369	PN2369	E	21
2N2369A	PN2369A	E	21
2N2483	2N5209	N	07
2N2484	2N5210	N	07
2N2604	2N5086	N	62
2N2605	2N5086	N	62
2N2894	MPS3640	A	65
2N289A	MPS3639	A	65
2N2904	PN2906	E	63
2N2904A	PN2906A	E	63
2N2905	PN2907	E	63
2N2905A	PN2907A	E	63
2N2906	PN2906	E	63
2N2906A	PN2906A	E	63
2N2907	PN2907	E	63
2N2907A	PN2907A	E	63
2N3009	MPS3646	N	22
2N3011	PN2369	N	21
2N3012	MPS3640	A	65
2N3013	MPS3646	E	22
2N3117	2N5210	N	07
2N3133	MPS3703	N	63
2N3134	MPS3645	N	63
2N3135	MPS3703	N	63
2N3136	MPS3645	N	63
2N3250	2N3905	A	66
2N3251	2N3906	A	66
2N3300	2N4401	A	13
2N3301	2N4400	A	13
2N3302	2N4401	A	13
2N3304	MPS3639	A	65
2N3944	2N3903	N	23
2N3947	2N3904	N	23
2N3962	2N5086	N	62
2N3964	2N5087	N	62
2N3965	2N5087	N	62
2N4208	MPS3640	N	65
2N4209	MPS3640	N	65

*E = Exact electrical equivalent
N = Near electrical equivalent
A = Approximate equivalent

Note: On "N" and "A" categories please refer to device specification section for deviation from metal can specifications.

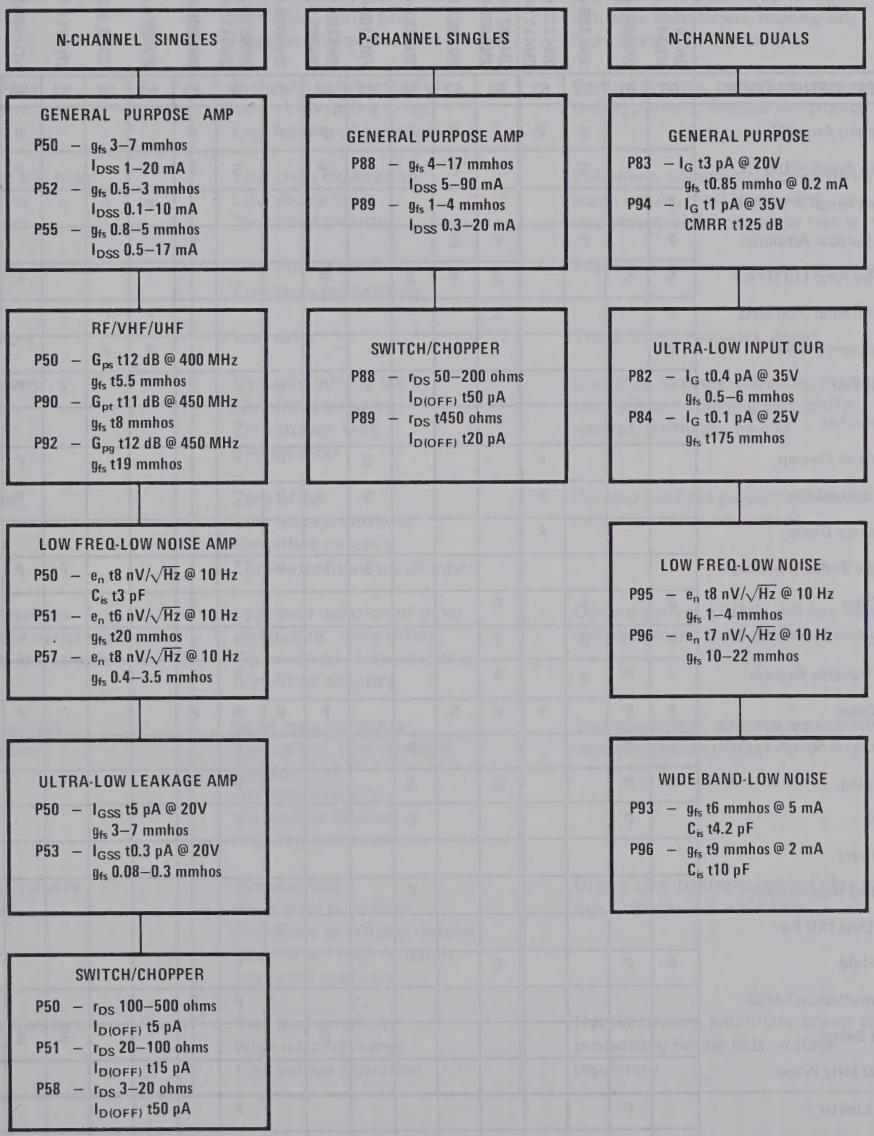
This list is for use when an alternative to a metal can transistor is needed.

To facilitate conversions on the most popular types National is offering the "PN" series, TO-92 devices that use the same die type and are screened to same electrical specifications. The TO-92 transistors produced by National Semiconductor are the most advanced Plastic Transistors ever manufactured. They utilize epoxy B encapsulation and a copper lead frame, to give a power dissipation of 625 mW @ $T_A = 25^\circ C$. These transistors provide electrical performance and reliability equivalent to their metal can versions in most applications where T_A does not exceed $150^\circ C$.

Choose The Proper JFET

National Semiconductor utilizes 18 different process type JFETs to cover, without compromise, the full spectrum of applications. Specific part number characteristics are summarized by separating into key application areas within the catalog. Each process is fully characterized in the Process Sheets and typical curves in tne latter part of the catalog. Note that the Process Sheets highlite a few of the more popular 2N and selected types.

To further simplify the selection procedure, the JFET Family Tree is included for quick identification. After narrowing down the process types, it is suggested that the process sheets and specific part number characteristics be consulted. The Application Guide will also prove useful.


N-CHANNEL SINGLES
GENERAL PURPOSE AMP
P50 – g_{fs} 3–7 mmhos
I_{DSS} 1–20 mA
P52 – g_{fs} 0.5–3 mmhos
I_{DSS} 0.1–10 mA
P55 – g_{fs} 0.8–5 mmhos
I_{DSS} 0.5–17 mA
RF/VHF/UHF
P50 – G_{ps} t12 dB @ 400 MHz
g_{fs} t5.5 mmhos
P90 – G_{pt} t11 dB @ 450 MHz
g_{fs} t8 mmhos
P92 – G_{pg} t12 dB @ 450 MHz
g_{fs} t19 mmhos
LOW FREQ-LOW NOISE AMP
P50 – e_n t8 nV/√Hz @ 10 Hz
C_{is} t3 pF
P51 – e_n t6 nV/√Hz @ 10 Hz
g_{fs} t20 mmhos
P57 – e_n t8 nV/√Hz @ 10 Hz
g_{fs} 0.4–3.5 mmhos
ULTRA-LOW LEAKAGE AMP
P50 – I_{GSS} t5 pA @ 20V
g_{fs} 3–7 mmhos
P53 – I_{GSS} t0.3 pA @ 20V
g_{fs} 0.08–0.3 mmhos
SWITCH/CHOPPER
P50 – r_{DS} 100–500 ohms
$I_{D(OFF)}$ t5 pA
P51 – r_{DS} 20–100 ohms
$I_{D(OFF)}$ t15 pA
P58 – r_{DS} 3–20 ohms
$I_{D(OFF)}$ t50 pA
P-CHANNEL SINGLES
GENERAL PURPOSE AMP
P88 – g_{fs} 4–17 mmhos
I_{DSS} 5–90 mA
P89 – g_{fs} 1–4 mmhos
I_{DSS} 0.3–20 mA
SWITCH/CHOPPER
P88 – r_{DS} 50–200 ohms
$I_{D(OFF)}$ t50 pA
P89 – r_{DS} t450 ohms
$I_{D(OFF)}$ t20 pA
N-CHANNEL DUALS
GENERAL PURPOSE
P83 – I_G t3 pA @ 20V
g_{fs} t0.85 mmho @ 0.2 mA
P94 – I_G t1 pA @ 35V
CMRR t125 dB
ULTRA-LOW INPUT CUR
P82 – I_G t0.4 pA @ 35V
g_{fs} 0.5–6 mmhos
P84 – I_G t0.1 pA @ 25V
g_{fs} t175 mmhos
LOW FREQ-LOW NOISE
P95 – e_n t8 nV/√Hz @ 10 Hz
g_{fs} 1–4 mmhos
P96 – e_n t7 nV/√Hz @ 10 Hz
g_{fs} 10–22 mmhos
WIDE BAND-LOW NOISE
P93 – g_{fs} t6 mmhos @ 5 mA
C_{is} t4.2 pF
P96 – g_{fs} t9 mmhos @ 2 mA
C_{is} t10 pF

t – typical

JFET Application Guide

National Semiconductor manufactures a broad line of silicon Junction Field Effect Transistors (JFETs). National's JFETs provide excellent performance in many areas such as RF amplifiers, analog switching, low input current amplifiers, low noise high impedance amplifiers and outstanding matched duals for operational amplifiers input applications.

The following FET guides enable the user when to use FETs and where to look for the best choice.

POPULAR PRODUCT TYPES	2N4416, 2N5485, 6 KE4416, 2N4302-4	2N4856-61, 2N4391-3	2N4338-41, 2N3684-7	2N4117-9, 2N3452-4 2N4117A-19A	2N3821-2, 2N4221-2 2N5457-9	2N4867-9, A	2N5432-4, NF580-5	FM1100A-11A	2N5196-9, 2N5545-7 2N3921-2	2N5902-9	2N5018-21, P1086-7E 2N5114-6	2N2608-9, 2N5460-62	2N5397, 8, E300	U310, E310-12	2N5911-12	NDF9401-10	2N5515-24, 2N6483-5	2N5564-6
PROCESS DESIGNATION	50	51	52	53	55	57	58	82	83	84	88	89	90	92	93	94	95	96
Low Current Amplifier			S	P	S	S		S	P	P		P				P	P	
Low Freq Ampli $\leq$100 Hz			S		S	P			P		S	S				P	P	
High Freq Ampli $>$100 MHz	P												P	P	P			P
General Purpose Amplifier	P		P		P	S						P						
Low Noise Amp (10 Hz $\bar{e}n$)	S	S			S	P	S		P							P	P	P
Low Noise Amp $>$50 MHz	P				S								P	P	P			P
High Frequency Mixer	P												P	P				
Dual Diff Pair								S	P	P					P	P	S	P
AGC Amplifier	P				P													
Electrometer Preamp				P				S		P						P		
Microvolt Amplifier				P				S		P						P		
Low Leakage Diode				P														
Diff/Angle Ended Inp. Stag.								S	P	P					P	P		P
Active Filter	P		S		P							S						
Oscillator	P		S		P							S						
Voltage Variable Resistor	P	P	S		P						P	P						
Hybrid Chips	P	P		P	P	S			P	P	P	P				P		
Analog/digital Switch		P					P				P							
Multiplexing	P	P			S		S				P							
Choppers		P					P				P							
Nixie Drivers																		
Reed Relay Replacement							P											
Sub pA Dual Diff Pair								P		P								
Sample-Hold	P	P			S						P							
Buffer Interface to CMOS											P	P						
Matched Switch									S						S	S		P
HF $\geq$400 MHz Prime													P	P				
Current Limiter		P									P							
Current Source			S	S	P							S						

P – Prime Choice S – Secondary (Alternate) Choice

ADVANTAGES OF USING FIELD-EFFECT TRANSISTORS

APPLICATION	ADVANTAGES	FINAL ASSEMBLY WHERE USED
DC Amplifiers	High Z_{in} Low drift duals Low noise	Transducers, military guidance systems, control systems, temp indicators, multimeters
Low frequency amplifiers	Small coupling capacitors Low noise, distortion High input impedance	Sound detection, microphones, inductive transducers, hearing aids, high impedance transducers
Operational amplifiers	Summing point essentially zero. Low device noise. Less loading of transducers	Control systems, potted op amps, test equipment, medical electronics
Medium and high frequency amplifiers	Low cross modulation Low device noise Simplified circuitry	FM tuners, communication received scope inputs, most instrumentation equipment, high impedance inputs
Mixers – 100 MHz and up	Low mixing noise Low cross modulation	FM tuners, communication receivers
Oscillators	Low drift	Transmitters, receivers, organ
Logic gates	Virtually infinite fan in Simplified circuitry Zero storage time Symmetrical	Guidance controls, computer market mini military teaching aids, traffic control, telemetry, couple
Choppers	Zero offset Low leakage currents Simplified circuitry Eliminates input transformers	Op amp modules guidance controls instrumentation equipment
AD Converters Multiplex switching (arrays) and sample hold	Improved isolation of input and output. Zero offset. Symmetrical. Low resistance Simplified circuitry	Control system, DVM's and any read-out equipment, medical electronics
Relay contact replacement	Solid state reliability Zero offset, High isolation Symmetrical No inductive spring No contact bounce High repetition rate	Test equipment, airborne equipment instrumentation market
Voltage variable resistor	Symmetrical Solid state reliability Functions as variable resistor. Low noise. High isolation Improved resolution	Organ, tone controls, control ckts to input operational amplifiers
Current limiters Sources	Two lead simplicity Wide selection range Low voltage operation	Hybrid circuits, amplifiers, power supply protection, timing ckts, voltage regulators

JFET Cross Reference Guide

31 COST EFFECTIVE PREFERRED TYPES §

Application	Type	Package	I_{DSS} (mA) Min/Max	g_{fs} (mmho) Min/Max	r_{DS} (Ω) Max	$\lvert V_{GS(OFF)}\rvert$ (V) Min/Max	Note	Process
N-Channel								
Low Leak GPA	2N4119A	TO-72	0.2/0.6	0.1/0.33		2/6	$I_{GSS} < 1$pA	53
Low I_D Amplifier	2N4338	TO-18	0.2/0.6	0.6/1.8		0.3/1	3:1 I_{DSS}	52
Low I_D Amplifier	2N5717	TO-92	0.2/1	0.4/1.6		0.5/5(1.2)		52
General Purpose Amplifier	2N3821	TO-72	0.5/2.5	1.5/4.5		/4		55
General Purpose Amplifier	2N4302	TO-106	0.5/5	1/		/4		55
General Purpose Amplifier	2N3822	TO-72	2/10	3/6.5		/6		55
General Purpose Amplifier	2N5458	TO-92	2/9	1.5/5.5		1/7		55
GPA/SW VHF/UHF	2N4416	TO-72	5/15	>4 @ 400 MHz	(150)	/6	400 MHz Performance	50
GPA/SW VHF/UHF	2N5486	TO-92	8/20	>3.5 @ 400 MHz	(150)	2/6	400 MHz Performance	50
VHF/UHF	2N5397	TO-72	10/30	>5.5 @ 450 MHz		1/6	Improved 2N4416	90
VHF/UHF	E300	TO-106	6/30	>4.5 @ 5 mA		1/6	Improved 2N5486	90
VHF/UHF Common Gate	U310	TO-52	20/60	10/20		1/6	$G_{P(CG)}$ 12 dB @ 450 MHz	92
VHF/UHF Common Gate	E310	TO-106	12/60	8/18		1/6.5	450 MHz $G_{P(CG)}$	92
Switch/Chopper	2N5433	TO-52	100/		7	3/9	$t_{on} < 5$ ns	58
Switch/Chopper	2N4856	TO-18	50/		25	4/10	Low $C_{is} \times r_{DS}$	51
Switch/Chopper	2N5638	TO-92	50/		30	/12(10)	Low $C_{is} \times r_{DS}$	51
Switch/Chopper	2N4392	TO-18	25/75		60	2/5	Low $C_{is} \times r_{DS}$	51
Switch/Chopper	2N5639	TO-92	25/		60	/8(5)	Low $C_{is} \times r_{DS}$	51
Switch/Chopper	2N4393	TO-18	5/30	(17)	100	0.5/3	Low Noise Amplifier	51
Switch/Chopper	2N5640	TO-92	5/	(17)	100	/6(4)	Low Noise Amplifier	51
GP Dual	2N3955	TO-71	0.5/5	1/3		1/4.5	10 mV, 25 μV/°C match	83
GP Dual	2N5197	TO-71	0.7/7	0.7/1.5 @ 0.2 mA		0.7/4.5	5 mV, 10 μV/°C match	83
Low Noise Dual	2N5566	TO-71	5/30	7.5/@ 2 mA	(50)	0.5/3	20 mV, 50 μV/°C match	96
Wide Band Dual	2N5912	TO-78	7/40	5/10 @ 5 mA		1/5	15 mV, 40 μV/°C match	93
Dual	NDF9407	TO-71	0.5/10	0.95/2 @ 0.2 mA		0.5/4	5 mV, 10 μV/°C, $I_G < 5$ pA @ 35V	94
P-Channel								
General Purpose Amplifier	2N2608	TO-18P	0.9/4.5	1/	(500)	1/4	I_{GSS} typical 10 pA	89
General Purpose Amplifier	2N5460	TO-92	1/5	1/4	(500)	0.75/6	$C_{iss} < 7$ pF	89
Switch/Chopper	2N5018	TO-18P	10/		75	/10	C_{iss} typical 12 pF	88
Switch/Chopper	P1086E	TO-106	10/		75	/10	Low $C_{is} \times r_{DS}$	88
Switch/Chopper	2N5019	TO-18P	5/	(10)	150	/5	I_{GSS} typical 50 pA	88
Switch/Chopper	P1087E	TO-106	5/	(10)	150	/5	$e_n = 10\ nV/\sqrt{Hz}$ @ 1 kHz	88

§ Should meet 95% of new design requirements. Where logical, metal and epoxy types are bracketed together to show similar types. Consult National Semiconductor Transistor/FET Catalog for full information. ( ) Typical

KEY: ★ Stock item — local distributor and/or factory. * Special order product — consult factory for delivery prior to entering order. † Special mark and/or electrical selection — readily available.

HOW TO USE THE GUIDE

This FET cross reference guide is designed to steer you to the more popular stock, lower cost standard National JFETs, from the thousands of types available from various manufacturers. Most special in-house numbers are close to JEDEC registered device types except for a minor selection or relaxation. On types missing from the list, a high probability exists NS can meet your need. If you are having delivery, quality, price, or performance problems, or desire a major source, the list will provide you the most likely National Semiconductor equivalent "stock item" for delivery from the National distributor or factory.

The NS alternate device selection was based on similar electrical characteristics. Interchangeability in particular applications is not guaranteed. Before using an alternate, compare alternate specifications to the original device data sheet. If the recommended alternate does not exactly meet your needs, feel free to contact your local NS Field Applications Engineer or factory.

On any of the FET types, National Semiconductor has the capability to do complete "Hi-Rel" processing for the most stringent military or medical application requirements.

JFET CROSS REFERENCE GUIDE TO INDUSTRY TYPES

NS AVAILABLE TYPE NUMBER	STATUS	NS ALTERNATE STOCK TYPE	NS AVAILABLE TYPE NUMBER	STATUS	NS ALTERNATE STOCK TYPE	NS AVAILABLE TYPE NUMBER	STATUS	NS ALTERNATE STOCK TYPE	NS AVAILABLE TYPE NUMBER	STATUS	NS ALTERNATE STOCK TYPE	NS AVAILABLE TYPE NUMBER	STATUS	NS ALTERNATE STOCK TYPE	NS AVAILABLE TYPE NUMBER	STATUS	NS ALTERNATE STOCK TYPE
2N2386	*	2N4381	2N3459	★	2N4220, A	2N4117A	★	2N4117A	2N5033	★	2N5460	2N5476	*	2N2608	2N6449	*	
2N2386A	*	2N4381	2N3460	★	2N4339	2N4118	★	2N4118	2N5045	★	2N3955	2N5484	★	2N5457	2N6450	*	
2N2497	*	2N3329	2N3465	*	2N4220, A	2N4118A	★	2N4118A	2N5046	★	2N3956	2N5485	★	2N5485	2N6451	*	NF6451
2N2498	*	2N3330	2N3466	*	2N3821	2N4119	★	2N4119	2N5047	★	2N3958	2N5486	★	2N5486	2N6452	*	NF6452
2N2499	*	2N3331	2N3573	*	2N5020	2N4119A	★	2N4119A	2N5078	★	2N4416	2N5515	★	2N5196	2N6453	*	NF6453
2N2500	*	2N3332	2N3574	*	2N5020	2N4139	★	2N4222	2N5103	★	2N3822	2N5516	★	2N5197	2N6454	*	NF6454
2N2606	*	2N5020	2N3575	*	2N5020	2N4220	★	2N4220	2N5104	★	2N4221	2N5517	★	2N5198	2N6483	★	2N5520
2N2607	*	2N5020	2N3578	*	2N2608	2N4220A	★	2N3821	2N5105	★	2N4416	2N5518	★	2N5199	2N6484	★	2N5521
•2N2608, JAN	★	2N2608	2N3684	★	2N3822	2N4221	★	2N4221	•2N5114, J, TX	★	2N5018	2N5519	★	2N3957	2N6485	★	2N5523
•2N2609, JAN	★	2N2609	2N3684A	†	2N4221, A	2N4221A	★	2N3822	•2N5115, J, TX	★	2N5018	2N5520	★	2N6483	14T	†	2N4224
2N2841	*	2N5020	2N3685	★	2N3821	2N4222	★	2N4222	•2N5116, J, TX	★	2N5019	2N5521	★	2N6483	42T	†	KE4092
2N2842	*	2N5020	2N3685A	†	2N4220, A	2N4222A	★	2N3822	2N5158	*	2N5434	2N5522	★	2N6484	58T	†	2N4302
2N2843	★	2N5020	2N3686	★	2N3821	2N4223	★	2N4223	2N5159	*	2N5433	2N5523	★	2N6485	59T	†	KE4416
2N2844	★	2N2608	2N3686A	†	2N3821	2N4223A	★	2N3823	2N5163	★	2N4304	2N5524	★	2N6485	100S	†	2N4304
2N3066	*	2N4339	2N3687	★	2N4338	2N4224	★	2N4224	2N5196	★	2N3954A	2N5543	*	2N3822	100U	†	2N3822
2N3067	*	2N4339	2N3687A	†	2N4338	2N4224A	★	2N3824	2N5197	★	2N5545	2N5544	*	2N3822	101S	†	2N5717
2N3068	*	2N4338	2N3695	*	2N3329	2N4302	★	2N5457	2N5198	★	2N5546	•2N5545, J, TX	★	2N5545	102M	†	2N5486
2N3069	★	2N3822	2N3696	*	2N3329	2N4303	★	2N5485	2N5199	★	2N5547	•2N5546, J, TX	★	2N5546	102S	†	2N4302
2N3070	★	2N3821	2N3697	*	2N5020	2N4304	★	2N5459	2N5245	★	2N5486	•2N5547, J, TX	★	2N5547	103M	†	2N5457
2N3071	★	2N4338	2N3698	*	2N5020	2N4338	★	2N3687	2N5246	★	2N5485	2N5549	†	2N4393	103S	†	2N5459
2N3084	*	2N3685	2N3819	★	2N3819	2N4339	★	2N3686	2N5247	★	2N5486	2N5555	★	2N5654	104M	†	2N5458
2N3085	*	2N3821	2N3820	★	2N3820	2N4340	★	2N3685	2N5248	★	2N3819	2N5556	★	2N3821	105M	†	2N5459
2N3086	*	2N3685	•2N3821, J, TX	★	2N3821	2N4341	★	2N3684	2N5257	†	2N5457	2N5557	★	2N4221	105U	†	2N4222
2N3087	*	2N3821	•2N3822, J, TX	★	2N3822	2N4342	★	2N3994	2N5258	†	2N5458	2N5558	★	2N5362	106M	†	2N5485
2N3088	*	2N4339	•2N3823, J, TX	★	2N3823	2N4343	★	2N3993	2N5259	†	2N5459	2N5561	★	NDF9406	107M	†	2N5486
2N3088A	*	2N3821	2N3824	★	2N3824	2N4360	★	2N5461	2N5260	†	2N5460	2N5562	★	NDF9408	110U	†	2N3821
2N3089	†	2N4339	2N3909	†	2N4381	2N4381	★	2N2609	2N5265	†	2N5020	2N5563	★	NDF9409	115U	†	2N4220
2N3089A	†	2N3821	2N3909A	†	2N3330	2N4382	★	2N3384	2N5266	†	2N5020	2N5564	★	2N5564	120U	†	2N3821
2N3112	*	2N5033	2N3921	★	2N5545	2N4391	★	2N4391	2N5267	†	2N3329	2N5565	★	2N5565	125U	†	2N4339
2N3113	*	2N5020	2N3922	★	2N5546	2N4392	★	2N4392	2N5268	†	2N3330	2N5566	★	2N5566	130U	†	2N4338
2N3277	*	2N5020	2N3934	†	2N3954	2N4393	★	2N4393	2N5269	†	2N2609	2N5592	†	2N3822	135U	†	2N4339
2N3278	*	2N5020	2N3935	†	2N3955A	2N4416	★	2N5398	2N5270	†	2N4381	2N5593	†	2N3822	155U	†	2N4416
2N3328	*	2N5020	2N3954	★	2N3954	•2N4416A, J, TX	★	2N5397	2N5277	*		2N5594	†	2N3822	182S	†	2N4391
2N3329	★	2N5021	2N3954A	★	2N3954A	2N4417	*	2N4416	2N5278	*		2N5638	★	2N5638	183S	†	2N3823
2N3330	★	2N2608	2N3955	★	2N3955	2N4445	*	NF4445	2N5358	★	2N3686	2N5639	★	2N5639	197S	†	2N4338
2N3331	★	2N4381	2N3955A	★	2N3955A	2N4446	*	NF4446	2N5359	★	2N3686	2N5640	★	2N5640	198S	†	2N4340
2N3332	†	2N2608	2N3956	★	2N3956	2N4447	*	NF4447	2N5360	★	2N4220	2N5647	*	2N3687	199S	†	2N4341
2N3333	*	2N5020	2N3957	★	2N3957	2N4448	*	NF4448	2N5361	★	2N4221	2N5648	*	2N3686	200S	†	2N4392
2N3334	*	2N5020	2N3958	★	2N3958	•2N4856, J, TX	★	2N4391	2N5362	★	2N3684	2N5649	*	2N3686	200U	†	2N4393
2N3335	*	2N5020	2N3966	★	2N3966	2N4856A	★	2N4391	2N5363	★	2N4416	2N5653	★	2N5639	201S	†	2N4391
2N3336	*	2N5020	2N3967	★	2N3822	•2N4857, J, TX	★	2N4392	2N5364	★	2N4222	2N5654	★	2N5640	202S	†	2N4392
2N3365	★	2N5718	2N3967A	★	2N3822	2N4857A	★	2N4392	2N5391	†	2N4867, A	2N5668	★	2N5457	203S	†	2N3821
2N3366	★	2N4339	2N3968	★	2N4220, A	•2N4858, J, TX	★	2N4093	2N5392	†	2N4868, A	2N5669	★	2N5485	204S	†	2N3821
2N3367	★	2N5716	2N3968A	★	2N3821	2N4858A	★	2N4393	2N5393	†	2N4869, A	2N5670	★	2N5486	210U	†	2N3822
2N3368	★	2N3822	2N3969	★	2N3821	•2N4859, J, TX	★	2N4856	2N5394	†	2N4869, A	2N5716	★	2N5716	231S	†	2N3954
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2N3381	*	2N4381	2N3994A	★	2N3994A	2N4868	★	2N5557	2N5452	★	2N3954A	2N5802	†	2N4393	588U	†	KE4416
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2N3455	★	2N3821	2N4093A	†	2N4858	2N5018	★	2N5114	2N5472	*	2N5020	2N5950	†	KE4416	756U	†	2N4224
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2N3457	★	2N4118	2N4095	†	2N4857	2N5020	★	2N5020	2N5474	*	2N5020	2N5952	†	2N4303	1278A	†	2N3821
2N3458	★	2N4222, A	2N4117	★	2N4117	2N5021	★	2N2608	2N5475	*	2N5020	2N5953	†	2N4302	1279A	†	2N3821

•MIL types soon available. Consult factory for delivery status.

JFET Cross Reference Guide

JFET CROSS REFERENCE GUIDE TO INDUSTRY TYPES (Con't)

NS AVAILABLE TYPE NUMBER	STATUS	NS ALTERNATE STOCK TYPE
1280A	†	2N4224
1281A	†	2N3822
1282A	†	2N4341
1283A	†	2N4340
1284A	†	2N4222
1285A	†	2N3821
1286A	†	2N4220
1325A	†	2N4222
1714A	†	2N4340
2000M	†	2N3823
2001M	†	2N3823
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2079A	†	2N3955
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2081A	†	2N5546
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2095M	†	2N3686
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2099A	†	2N5546
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2132U	†	2N3955
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2138U	†	2N3958
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MMF4	†	2N3922
MMF5	†	2N5199
MMF6	†	2N5546
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MPF103	★	2N5457
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MPF109	★	2N5459
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MPF112	★	2N5459
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U285	★	2N3957
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U300	†	2N5114
U301	†	2P5115
U304	†	2N5114
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U306	†	2N5116
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UC21	*	2N3687
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BC264B	†	2N4304	DN3370B	†	2N4338	FM3958	*	2N3958	NDF9401	★	NDF9401	TIS74	★	KE4857	UC130	†	2N4338
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BC264D	†	KE4416	DN3436B	†	2N4222A	FT0654A	†	2N3824	NDF9403	★	NDF9403	TIS78	*		UC150	†	2N4416
BF244	†	2N5486	DN3437A	†	2N3437	FT0654B	†	2N3824	NDF9404	★	NDF9404	TIS79	*		UC155	†	2N4416
BF244A	†	2N5484	DN3437B	†	2N4220A	FT0654C	†	2N4221	NDF9405	★	NDF9405	TIS88	★	2N5486	UC200	†	2N4393
BF244B	†	2N5485	DN3438A	†	2N3438	FT0654D	†	2N4221	NDF9406	★	NDF9406	TIX33	†	2N4857	UC201	†	2N4416
BF244C	†	2N5486	DN3438B	†	2N4339	FT0654E	†	2N4220	NDF9407	★	NDF9407	TIX41	†	2N4391	UC210	†	2N3822
BF245	†	KE4416	DN3458A	†	2N3458	FT0655A	†	2N4856A	NDF9408	★	NDF9408	TIX42	†	2N4392	UC220	†	2N4220
BF246	†	2N5654	DN3458B	†	2N4222A	FT0655B	†	2N4858A	NDF9409	★	NDF9409	TN4117	*	2N4117	UC240	†	2N4393
BF246A	†	2N5639	DN3459A	†	2N3459	FT0655C	†	2N3972	NDF9410	★	NDF9410	TN4117A	*	2N4117	UC241	†	2N3822
BF246B	†	2N5638	DN3459B	†	2N4220A	FT3820	†	2N5461	NF500	†	2N4224	TN4118	*	2N4118	UC250	★	2N4391
BF246C	†	2N5653	DN3460A	†	2N3460	FT3909	†	2N2608	NF501	†	2N4224	TN4118A	*	2N4118	UC251	★	2N4392
BF247	†	KE4091	DN3460B	†	2N4220A	GET5457	†	2N5457	NF506	†	2N3823	TN4119	*	2N4119	UC400	†	2N2609
BF256	†	KE4416	DNX1, A	*	2N3822	GET5458	†	2N5458	NF510	★	2N4092	TN4119A	*	2N4119	UC401	†	2N5019
BF256A	†	2N5246	DNX2, A	*	2N3821	GET5459	†	2N5459	NF511	★	2N4092	TN4338	†	2N4338	UC410	†	2N2609
BF256B	†	KE4416	DNX3, A	*	2N4338	HEP801	†	2N4221	NF520	†	2N4224	TN4339	†	2N4339	UC420	*	2N3329
BF256C	†	KE4416	DNX4, A	*	2N3822	HEP802	†	KE4416	NF521	†	2N4220	TN4340	†	2N4340	UC450	†	2N5114
BF320	†	2N5461	DNX5, A	*	2N3821	HEP803	†	2N2608	NF522	†	2N4224	TN4341	†	2N4341	UC451	★	2N5116
BF348	†	2N5555	DNX6, A	*	2N4338	HEPF0021	†	KE4416	NF523	†	2N4220	TP5114	†	2N5114	UC588	†	2N4416
BFR45	†	2N4416	DNX7, A	*	2N4341	HEPF1035	†	2N5461	NF530	†	2N3822	TP5115	†	2N5115	UC701	†	2N4220
BFS21	†	2N5199	DNX8, A	*	2N4340	HEPF2004	†	2N5397	NF531	†	2N3821	TP5116	†	2N5116	UC703	†	2N3822
BFS21A	†	2N5199	DNX9, A	*	2N4339	HEPF2005	†	2N3822	NF532	†	2N3822	U110	*	2N5020	UC704	†	2N3822
BFS67	†	2N3821	DU4339	*	2N5905	IMF3954	†	2N5197	NF533	†	2N3821	U112	*	2N2609	UC705	†	2N3824
BFS67P	†	2N4303	DU4340	*	2N3958	IMF3954A	†	2N5196	NF550	†	2N3958	U114	*	2N5020	UC707	†	2N4391
BFS68	†	2N3823	E100	★	2N4304	IMF3955	†	2N5198	NF580	★	NF4445	U133	*	2N5020	UC714	†	2N4416
BFS68P	†	KE4416	E101	★	2N5717	IMF3955A	†	2N5198	NF581	★	NF4447	U146	*	2N5020	UC714E	†	2N4416
BFS70	†	2N3821	E102	★	2N5457	IMF3956	†	2N5199	NF582	★	2N5434	U147	*	2N5020	UC734	★	2N4416
BFS71	†	2N3822	E103	★	2N5459	IMF3957	†	2N5199	NF583	★	2N5434	U148	*	2N5020	UC734E	★	KE4416
BFS72	†	2N3823	E105	*	NF4445	IMF3958	†	2N5199	NF584	★	NF4446	U149	*	2N5020	UC750	†	2N4338
BFS73	†	2N3821	E106	*	NF4447	IT108	†	KE4416	NF585	★	2N5433	U168	†	2N2608	UC751	†	2N4340
BFS74	†	2N4856	E107	*	2N5434	IT109	†	2N5397	NF3819	†	2N3823	U182	†	2N4857	UC752	†	2N4341
BFS75	†	2N4857	E108	*	NF4447	ITE3066	†	2N4302	NF4302	†	2N4302	U183	†	2N3823	UC753	†	2N4392
BFS76	†	2N4858	E109	*	NF4448	ITE3067	†	2N5717	NF4303	†	2N4303	U184	†	2N4416	UC754	†	2N4340
BFS77	†	2N4859	E110	*	2N5434	ITE3068	†	2N5716	NF4304	†	2N4304	U197	†	2N4338	UC755	†	2N4341
BFS78	†	2N4860	E111	†	KE4391	ITE4117	†	2N4117	NF4445	★	2N5432	U198	†	2N4340	UC756	†	2N4224
BFS79	†	2N4861	E112	†	KE4392	ITE4118	†	2N4118	NF4446	★	2N5433	U199	†	2N4341	UC805	†	2N3331
BFS80	†	2N4416A	E113	†	KE4393	ITE4119	†	2N4119	NF4447	★	2N5432	U200	†	2N4393	UC807	†	2N4861
BFW10	†	2N3823	E114	†	2N5555	ITE4338	†	2N5717	NF4448	★	2N5433	U201	†	2N4392	UC814	†	2N3331
BFW11	†	2N3822	E174	†	P1086E	ITE4339	†	2N4302	NF5163	†	2N5163	U202	†	2N4391	UC851	†	2N2608
BFW54	†	2N3822	E175	†	P1087E	ITE4340	†	2N4302	NF5457	†	2N5457	U203	†	2N4220A	UC853	*	2N5020
BFW55	†	2N3822	E176	†	P1087E	ITE4341	†	2N4303	NF5458	†	2N5458	U204	†	2N4220A	UC854	*	2N2608
BFW56	†	2N4869	E201	†	2N5717	ITE4391	★	KE4391	NF5459	†	2N5459	U221	†	2N4857	UC855	*	2N2609
BFW61	†	2N4224	E202	†	2N5457	ITE4392	★	KE4392	NF5485	†	2N5485	U222	†	2N4856	UC2130	*	2N3954
BSV22	†	2N4416	E203	†	2N5459	ITE4393	★	KE4393	NF5486	†	2N5486	U231	★	2N3954	UC2132	*	2N3955
BSV78	†	2N4856A	E210	†	KE4416	ITE4416	†	KE4416	NF5555	†	2N5555	U232	★	2N3955	UC2134	*	2N3956
BSV79	†	2N4857A	E211	†	E300	ITE4867	†	2N4867	NF5638	†	2N5638	U233	★	2N3956	UC2136	*	2N3958
BSV80	†	2N4858A	E212	†	E300	ITE4868	†	2N4868	NF5639	†	2N5639	U234	★	2N3957	UC2138	*	2N3958
C94	†	2N5457	E230	*	2N4867	ITE4869	†	2N4869	NF5640	†	2N5640	U235	★	2N3958	UC2139	*	2N3958
C94A	†	2N5457	E231	*	2N4868	KE510	★	2N5654	NF5653	†	2N5653	U240	†	NF4445	UC2147	*	2N3958
C94E	†	2N5457	E232	*	2N4869	KE511	★	2N5654	NF5654	†	2N5654	U241	†	NF4446	UC2148	*	2N3958
C95	†	2N5457	E270	*	2N5019	KE3684	★	2N5458	NKT80111	*	2N5457	U242	†	NF4447	UC2149	*	2N3958
C95A	†	2N5457	E271	*	2N5019	KE3685	★	2N5457	NKT80112	*	2N5457	U243	†	NF4448	UT100	*	
C95E	†	2N5459	E300	★	E300	KE3686	★	2N5717	NKT80113	*	2N5457	U244	†	NF4446	UT101	*	
C96E	†	2N5459	E304	†	KE4416	KE3687	★	2N5717	NKT80211	*	2N5459	U248	†	2N5902	VCR2N	†	2N4857
C97E	*	2N3955	E305	†	2N5484	KE3823	★	2N5486	NKT80212	*	2N5459	U248A	†	2N5906	VCR3P	†	2N5115
C98E	*	2N3955	E308	★	U308	KE3970	★	2N5638	NKT80213	*	2N5459	U249	†	2N5903	VCR4N	†	2N3684
C413E	†	KE4391	E309	★	U309	KE3971	★	2N5639	NKT80214	*	2N5459	U249A	†	2N5907	VCR5P	†	2N3331
C413N	†	2N4859	E310	★	U310	KE3972	★	2N5640	NKT80215	*	2N5458	U250	†	2N5904	VCR6P	†	2N3330
C610	†	2N4392	E400	*	2N3954	KE4091	★	2N5638	NKT80216	*	2N5458	U250A	†	2N5908	VCR7N	†	2N4119
C611	†	2N5360	E401	*	2N3955	KE4092	★	2N5639	NPC108A	*	2N5485	U251	†	2N5905	VCR10N	†	2N4224
C612	†	2N5360	E402	*	2N3956	KE4093	★	2N5640	NPC211N	*	2N5457	U251A	†	2N5909	VCR11N	*	2N5912
C613	†	2N5360	E413	*	2N3955	KE4220	★	2N4302	NPC212N	*	2N5457	U252	†	2N5911	VCR20N	*	
C614	†	2N5358	E414	*	2N3957	KE4221	★	2N5458	NPC213N	*	2N5458	U253	†	2N5912	WK5457	†	2N5457
C615	†	2N5360	E415	*	2N3958	KE4222	★	U1837E	NPC214N	*	2N5457	U254	†	2N4859	WK5458	†	2N5458
C620	†	2N5358	E420	*	2N5911	KE4223	★	U1837E	NPC215N	*	2N5457	U255	†	2N4860	WK5459	†	2N5459
C621	†	2N5358	E421	*	2N5912	KE4224	★	2N5163	NPC216N	*	2N5458	U256	†	2N4861			
C622	†	2N5358	E430	*	U430	KE4391	★	2N5638	P1003	*	2N5020	U257	★	2N5912			
C623	†	2N5358	E431	*	U431	KE4392	★	2N5639	P1004	*	2N3329	U266	*				
C624	†	2N5358	FE100	†	2N3821	KE4393	★	2N5640	P1005	*	2N2609	U273	†	2N4119			
C625	†	2N5358	FE100A	†	2N3821	KE4416	★	2N5486	P1027	*	2N3329	U273A	†	2N4119A			
C650	†	2N5358	FE102	†	2N4119	KE4856	★	2N5638	P1028	*	2N3331	U274	†	2N4119			
C651	†	2N5358	FE102A	†	2N4119	KE4857	★	2N5639	P1029	*	2N3331	U274A	†	2N4119A			
C652	†	2N5358	FE104	†	2N4118	KE4858	★	2N5639	P1069E	*	2N5640	U275	†	2N4119			
C653	†	2N5358	FE104A	†	2N4118	KE4859	★	2N5638	P1086E	★	2N5018	U275A	†	2N4119A			
C673	†	2N4341	FE200	†	2N3821	KE4860	★	2N5639	P1087E	★	2N5019	U280	★	2N3954			
C674	†	2N4341	FE202	†	2N3821	KE4861	★	2N5639	P1117E	*	2N5640	U281	★	2N3954			

•MIL types soon available. Consult factory for delivery status.

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SATURATED SWITCHES

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) @ V_{CB} (V) Max		h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max	& $V_{BE(sat)}$ (V) Min	Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
2N706	TO-18	25	15	3	500	15	20		10	1	0.6		0.9	10	6	200		10	75		9	21
JAN2N706	TO-18	25	15	5	100	15	30	120	10	1	0.5	0.7	0.9	10	6	200	700	10	75		9	21
							20		1	1												
							10		0.1	1												
2N708	TO-52	40	15	5	25	20	30	120	10	1	0.4	0.72	0.8	10	6	300		10				22
2N743	TO-18	20	12	5	1μA	20	10		1	0.25		0.65	0.85	10	5				24		8	21
							20	60	10	0.35			1.5	100								
							10		100	1												
2N744	TO-18	20	12	5	1μA	20	20		1	0.25		0.65	0.85	10	5	282		10	24			21
							40	120	10	0.35			1.5	100								
							20		100	1												
2N753	TO-18	25	15	5			40	120	10	1	0.6		0.9	10	5	200		10				21
2N834	TO-18	40		5	500	20	25		10	1	0.25		0.9	10	4	350		10	75			21
2N2369	TO-18	40	15	4.5	400	20	40	120	10	1	0.25	0.7	0.85	10	4	500		10	18		1	21
							20		100	2												
2N2369A	TO-18	40	15	4.5	400	20	40	120	10	0.35	0.2	0.7	0.85	10	4	500		10	18		1	21
							20		100	1	0.5		1.6	100								
JAN2N2369A	TO-18	40	15	4.5	30	20	40	120	10	0.35	0.2	0.7	0.85	10	4	500		10	18		1	21
							30	120	30	0.4	0.25		1.15	30								
							40	120	10	1	0.5		1.6	100								
							20	120	100	1												
JANTX2N2369A	TO-18	40	15	4.5	400	20	40	120	10	0.35	0.30	0.7	0.85	10	4	500		10	18		1	21
							40	120	10	1	0.25		1.15	30								
							30	120	30	0.4	0.50		1.6	100								
							20	120	100	1												
JANTXV2N2369A	TO-18	40	15	4.5	400	20	40	120	10	0.35	0.30	0.7	0.85	10	4	500		10	18		1	21
							40	120	10	1	0.25		1.15	30								
							30	120	30	0.4	0.50		1.6	100								
							20	120	100	1												
2N3009	TO-52	40	15	4	500	20	30	120	30	0.4	0.18	0.75	0.95	30	5	350		30	25		5	22
					I_{CES}		25		100	0.5	0.28		1.2	100								
							15		300	1	0.5		1.7	300								
2N3011	TO-18	30	12	5			30	120	10	0.35	0.2	0.72	0.87	10	4	400		20	20		5	21
							12		100	1	0.5		1.6	100								
2N3013	TO-52	40	15	4	300	20	30	120	30	0.4	0.18	0.75	0.95	30	5	350		30	25		5	22
					I_{CES}		25		100	0.5	0.28		1.2	100								
							15		300	1	0.5		1.7	300								
2N3014	TO-52	40	20	5	300	20	30	120	30	0.4	0.18		0.8	10	5	350		30	25		10	28
					I_{CES}		25		10	0.4	0.18		0.95	30								
							25		100	1	0.35		1.2	100								

Test Conditions:

1. I_C = 10 mA, I_{B1} = 3.0 mA, I_{B2} = 1.5 mA
2. I_C = 300 mA, V_{CE} = 25V, I_{B1} = I_{B2} = 30 mA
3. I_C = 500 mA, V_{CE} = 25V, I_{B1} = I_{B2} = 50 mA
4. I_C = 500 mA, V_{CC} = 30V, I_{B1} = I_{B2} = 50 mA
5. V_{CC} = 10V, I_C = 300 mA, I_{B1} = I_{B2} = 30 mA
6. I_C = 1.0A, V_{CC} = 30V, I_{B1} = I_{B2} = 100 mA
7. V_{CC} = 3.0V, I_C = 10 mA, I_{B1} = I_{B2} = 3.3 mA
8. I_C = 10 mA, V_{CC} = 3.0V, I_{B1} = 3.0 mA, I_{B2} = 1.5 mA
9. V_{CC} = 3.0V, I_C = 10 mA, I_{B1} = 3.0 mA, I_{B2} = 1.0 mA
10. V_{CC} = 2.0V, I_C = 30 mA, I_{B1} = 3.0 mA, I_{B2} = 3.0 mA
11. V_{CC} = 30V, I_C = 300 mA, I_{B1} = I_{B2} = 30 mA
12. V_{CC} = 30V, I_C = 1.0A, I_{B1} = I_{B2} = 100 mA
13. I_C = 10 mA, V_{CC} = 3.0V, I_{B1} = I_{B2} = 1.0 mA
14. V_{CC} = 10.7V, I_C = 1.0A, I_{B1} = I_{B2} = 100 mA

($t = t_s + t_f$)

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SATURATED SWITCHES (Cont.)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) @ V_{CB} (V) Max	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max	& $V_{BE(sat)}$ (V) Min	$V_{BE(sat)}$ (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
2N3015	TO-5 (Lo-Profile)	60	30	5	200 30 I_{CES}	30	120	150	10	0.4		1.2	150	8	250		50	60		2	25
						10		300	0.7	1.0		1.6	500								
2N3252	TO-5 (Lo-Profile)	60	30	5	500 40	30		150	1	0.3		1.0	150	12	200		10	70†		4	25
						30	90	500	1	0.5	0.7	1.3	500								
						25		1A	5	1.0		1.8	100								
2N3253	TO-5 (Lo-Profile)	75	40	5	500 60	25		150	1	0.35		1.0	150	12	175		50	70†		4	25
						25	75	375	1	0.6		0.7	500								
						20		750	5	1.2		1.8	1A								
2N3444	TO-5 (Lo-Profile)	80	50	5	500 60	20		150	1	0.35		1.0	150	12	150		50	70†		4	25
						20	60	500	1	0.6	0.7	1.3	500								
						15		1A	5	1.2		1.8	1A								
2N3605	TO-92(74)		14		500 18	30		10	1	0.25		0.85	10	6	300		10	45		9	21
2N3606	TO-92(74)		14		500 18	30		10	1	0.25		0.85	10	6	300		10	60		9	21
2N3607	TO-92(74)		14		500 18	30		10	1	0.25		0.85	10	6	300		10	70		9	21
2N3646	TO-106	40	15	5	500 20	30	120	30	0.4	0.2	0.75	0.95	30	5	350		30	28		5	22
						25		100	0.5	0.28		1.2	100								
						15		300	1	0.5		1.7	300								
2N3722	TO-5 (Lo-Profile)	80	60	6	500 40 I_{CES}	25		10	1	0.25		0.75	10	10	300		50	100		4	24
						40	150	100	1	0.22		0.85	100								
						20		300	2	0.37		1.1	300								
						15		500	2	0.5	0.86	1.2	500								
						12		800	5	2		1.5	800								
2N3723	TO-5 (Lo-Profile)	100	80	6	500 50 I_{CES}	25		10	1	0.25		0.75	10	9	300		50	130		4	24
						40	150	100	1	0.28		0.85	100								
						15		300	2	0.44		1.1	300								
						15		500	3	0.75	0.86	1.2	500								
						12		800	5												
2N3724	TO-5 (Lo-Profile)	50	30	6	1.7μA 40	60	150	100	1	0.2		0.86	100	12	300		50	60		4	25
						40		300	1	0.25		0.76	10								
						30		1A	5	0.32		1.1	300								
						30		10	1	0.42	0.9	1.2	500								
						25		800	2	0.65		1.5	800								
										0.75		1.7	1A								
2N3724A	TO-5 (Lo-Profile)	50	30	6	500 40	30		10	1	0.25		0.76	10	12	300		50	60		4	25
						60	150	100	1	0.2		0.86	100					50		6	
						40		300	1	0.32		1.1	300								
						35		500	1	0.42	0.9	1.2	500								
						30		800	2	0.65		1.3	800								
						30		1A	5	0.75	0.9	1.4	1A								
						25		1.5A	5												
2N3725	TO-5 (Lo-Profile)	80	50	6	1.7μA 60	60	150	100	1	0.25		0.76	10	10	300		50	60		4	25
						40		300	1	0.4		1.1	300								
						35		500	1	0.52	0.9	1.2	500								
						30		10	1	0.8		1.5	800								
						20		800	2	0.95		1.7	1A								
						25		1A	5												
2N3725A	TO-5 (Lo-Profile)	80	50	6	500 60	30		10	1	0.25		0.76	10	10	300		50	60		4	25
						60	150	100	1	0.26		0.86	100					50		6	
						40		300	1	0.4		1.1	300								
						35		500	1	0.52	0.9	1.2	500								
						25		800	2	0.8		1.3	800								
						25		1A	5	0.9	0.9	1.4	1A								
						20		1.5A	5												

2N3734	TO-5 (Lo-Profile)	50	30	5		35 40 35 30 30	 120 	10 150 500 1A 1.5A	1 1 1 1.5 5	0.2 0.3 0.5 0.9	 0.9	0.8 1.0 1.2 1.4	10 150 500 1A	9	300	50	60		6	01
2N3734A	TO-5 (Lo-Profile)	50	30	5	200 25 I_{CEX}	35 40 35 30 30	 120 	10 150 500 1A 1.5A	1 1 1 1.5 5	0.2 0.3 0.5 0.9	 0.9	0.8 1 1.2 1.4	10 150 500 1A	9	250	50	40†		6	01
2N4013	TO-18 (Solid)	50	30	6	1.7μA 40	30 60 40 35 25 30	 150 	10 100 300 500 800 1A	1 1 1 1 2 5	0.25 0.2 0.32 0.42 0.65 0.75	 0.9 	0.76 0.86 1.1 1.2 1.5 1.7	10 100 300 500 800 1A	12	300	50	60		4	25
2N4014	TO-18 (Solid)	80	50	6	1.7μA 60	30 60 40 35 20 25	 150 	10 100 300 500 800 1A	1 1 1 1 2 5	0.25 0.26 0.4 0.52 0.8 0.95	 0.9 	0.76 0.86 1.1 1.2 1.5 1.7	10 100 300 500 800 1A	10	300	50	60		4	25
2N4047	TO-5	80	50	6	1.7μA 60	20 40 30 20 15 15	 150 	10 100 300 500 800 1A	1 1 1 1 2 5	0.25 0.26 0.4 0.52 0.8 0.95	 0.9 	0.76 0.86 1.1 1.2 1.5 1.7	10 100 300 500 800 1A	10	250	50	60		4	25
2N4274	TO-106	30	12	4.5		35 18	120 	10 100	1 1	0.2 0.5	0.72 	0.85 1.6	10 100	4	400	10	12		7	21
2N4275	TO-106	40	15	4.5		30 18	120 	10 100	1 1	0.2 0.5	0.72 	0.85 1.6	10 100	4	400	10	12		7	21
2N4294	TO-92(74)	30	12	4.5	400 20	30 20	120 	10 100	1 2	0.25	0.6	0.9	10	5	400	10	20		1	21
2N4295	TO-92(74)	40	15	5	100 20	40 20	120 	10 100	1 2	0.25	0.6	0.9	10	4	500	10	15		1	21
2N5029	TO-92(74)	40	15	4.5	250 20 I_{CES}	40 20	120 	10 100	1 2	0.25	0.72	0.87	10	4	500	10	26†		13	21
2N5030	TO-92(74)	30	12	4	250 20 I_{CES}	30		10	1	0.25	0.72	0.87	10	4	400	10	30		13	21
2N5134	TO-106	20	10	3.5	400 15	20 15	150 	10 30	1 0.4	0.25	0.7	0.9	10	4	250	10	18		7	21
2N5189	TO-5 (Lo-Profile)	60	35	5	500 30	30 35		100 500	1 1	1		1.5	1A	12	250	50	70		14	25
2N5224	TO-92(72)	25	12	5	500 15	40 15	400 	10 100	1 1	0.35		0.90	10	4	250	10	60†		8	21
2N5769	TO-92(72)	40	15	4.5	400 20	40 40 30 20	120 120 	10 10 30 100	1 0.35 0.4 1	0.2 0.25 0.5	0.7 	0.85 1.15 1.6	10 30 100	4	500	10	18		1	21

Test Conditions:

1. I_C = 10 mA, I_{B1} = 3.0 mA, I_{B2} = 1.5 mA
2. I_C = 300 mA, V_{CE} = 25V, I_{B1} = I_{B2} = 30 mA
3. I_C = 500 mA, V_{CE} = 25V, I_{B1} = I_{B2} = 50 mA
4. I_C = 500 mA, V_{CC} = 30V, I_{B1} = I_{B2} = 50 mA
5. V_{CC} = 10V, I_C = 300 mA, I_{B1} = I_{B2} = 30 mA
6. I_C = 1.0A, V_{CC} = 30V, I_{B1} = I_{B2} = 100 mA
7. V_{CC} = 3.0V, I_C = 10 mA, I_{B1} = I_{B2} = 3.3 mA
8. I_C = 10 mA, V_{CC} = 3.0V, I_{B1} = 3.0 mA, I_{B2} = 1.5 mA
9. V_{CC} = 3.0V, I_C = 10 mA, I_{B1} = 3.0 mA, I_{B2} = 1.0 mA
10. V_{CC} = 2.0V, I_C = 30 mA, I_{B1} = 3.0 mA, I_{B2} = 3.0 mA
11. V_{CC} = 30V, I_C = 300 mA, I_{B1} = I_{B2} = 30 mA
12. V_{CC} = 30V, I_C = 1.0A, I_{B1} = I_{B2} = 100 mA
13. I_C = 10 mA, V_{CC} = 3.0V, I_{B1} = I_{B2} = 1.0 mA
14. V_{CC} = 10.7V, I_C = 1.0A, I_{B1} = I_{B2} = 100 mA

($t = t_s + t_f$)

NPN Transistors

SATURATED SWITCHES (Cont.)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) @ V_{CB} (V) Max		h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max	& $V_{BE(sat)}$ (V) Min	$V_{BE(sat)}$ (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
2N5772	TO-92(72)	40	15	5	500	20	30	120	30	0.4	0.2	0.75	0.95	30	5	350		30	28		5	22
							25		100	0.5	0.28		1.2	100								
							15		300	1	0.5		1.7	300								
2N6375	TO-18 (Solid)	75	40	6	200	40	60		10	1	0.25		0.8	100	10	300		50	20-40		11	01
							60		100	1	0.35	0.8	0.9	300					20-40		4	
							50		300	1	0.4	0.85	1	500					15-35		12	
							30	90	500	1	0.55	0.95	1.2	1A								
							20		1A	1												
2N6376	TO-5 (Lo-Profile)	75	40	6	200	40	60		10	1	0.25		0.8	100	10	300		50	20-40		11	01
							60		100	1	0.35	0.8	0.9	300					20-40		4	
							50		300	1	0.4	0.85	1	500					15-35		12	
							30	90	500	1	0.55	0.95	1.2	1A								
							20		1A	1												
EN706	TO-106	25	15	3	500	15	20		10	1	0.6		0.9	10	6	200		10				21
EN708	TO-106	40	15	5	50	20	30	120	10	1	0.4	0.72	0.85	10	6	300		10	75		9	22
							15		0.5	1												
EN744	TO-106	20	12	5	1μA	20	20			0.25		0.65	0.85	10		290		10	24		8	21
							40	120		0.35			1.5	100								
							20			1												
EN2369A	TO-106	40	15	4.5	400	20	40		10	0.35	0.2	0.7	0.85	10	4	500		10	18		8	21
					I_{CES}		30		30	0.4	0.25		1.15	30								
							20		100	1	0.5		1.6	100								
MPS706	TO-92(72)	15	15	3	500	15	20		10	1	0.6		0.9	10	6	200		10	75		8	21
MPS834	TO-92(72)	40		5	500	20	25		10	1	0.25		0.9	10	4	350		10	30		9	21
											0.4			50								
MPS2713	TO-92(72)	18	15	5	500	18	30	90	2	4.5	0.3		1.3	50								21
MPS2714	TO-92(72)				500	18	75	225	2	4.5	0.3	0.6	1.3	50								21
MPS3646	TO-92(72)	40	15	5			30	120	30	0.4	0.2	0.75	0.95	30	5	350		30	28		5	22
							25		100	0.5	0.28		1.2	100								
							15		300	1	0.5		1.7	300								
PN2369	TO-92(72)	40	15	4.5	400	20	40	120	10	1	0.25	0.7	0.85	10	4	500		10	18		1	21
							20		100	2												
PN2369A	TO-92(72)	40	15	4.5	400	20	40	120	10	1	0.2	0.7	0.85	10	4	500		10	18		1	21
							40		10	0.35	0.25		1.5	30								
							30		30	0.4	0.5		1.6	100								
							20		100	1												

Test Conditions:

1. I_C = 10 mA, I_{B1} = 3.0 mA, I_{B2} = 1.5 mA
2. I_C = 300 mA, V_{CE} = 25V, $I_{B1} = I_{B2}$ = 30 mA
3. I_C = 500 mA, V_{CE} = 25V, $I_{B1} = I_{B2}$ = 50 mA
4. I_C = 500 mA, V_{CC} = 30V, $I_{B1} = I_{B2}$ = 50 mA
5. V_{CC} = 10V, I_C = 300 mA, $I_{B1} = I_{B2}$ = 30 mA
6. I_C = 1.0A, V_{CC} = 30V, $I_{B1} = I_{B2}$ = 100 mA
7. V_{CC} = 3.0V, I_C = 10 mA, $I_{B1} = I_{B2}$ = 3.3 mA
8. I_C = 10 mA, V_{CC} = 3.0V, I_{B1} = 3.0 mA, I_{B2} = 1.5 mA
9. V_{CC} = 3.0V, I_C = 10 mA, I_{B1} = 3.0 mA, I_{B2} = 1.0 mA
10. V_{CC} = 2.0V, I_C = 30 mA, I_{B1} = 3.0 mA, I_{B2} = 3.0 mA
11. V_{CC} = 30V, I_C = 300 mA, $I_{B1} = I_{B2}$ = 30 mA
12. V_{CC} = 30V, I_C = 1.0A, $I_{B1} = I_{B2}$ = 100 mA
13. I_C = 10 mA, V_{CC} = 3.0V, $I_{B1} = I_{B2}$ = 1.0 mA
14. V_{CC} = 10.7V, I_C = 1.0A, $I_{B1} = I_{B2}$ = 100 mA

($t = t_s + t_f$)

NPN Transistors

RF-IF AMPS AND OSCILLATORS

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) @ V_{CB} (V) Max		h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(sat)}$ (V) & Max	$V_{BE(sat)}$ (V) Min	$V_{BE(sat)}$ (V) Max	@ I_C (mA)	C_{cb}/C_{re} (pF) Min	C_{cb}/C_{re} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	NF (dB) @ Freq (MHz) Max		Process No.
2N917	TO-72	30	15	3	1 μA	15	20		3	1	0.5		0.87	3		1.7¶	500		4	6	60	43
2N918	TO-72	30	15	3	10	15	20		3	1	0.4		1	10		1.7¶	600		4	6	60	43
JAN2N918	TO-72	30	15	3	10	15	20		10	10	0.4		1	10		1.7¶	600		4	6	60	43
							10		0.5	10												
							20	200	3	1												
JANTX2N918	TO-72	30	15	3	10	15	10		0.5	10	0.4		1	10		1.7¶	600		4	6	60	43
							20		10	10												
JANTXV2N918	TO-72	30	15	3	10	15	10		0.5	10	0.4		1	10		1.7¶	500		4	6	60	43
							20		10	10												
2N2857	TO-72	30	15	2.5	10	15	30	150	3	1						1	1000	1900	5	4.5	450	42
2N3478	TO-72	30	15	2	20	1	25	150	2	8						1	750	1600	5	4.5	200	42
2N3563	TO-106	30	12	2	50	15	20	200	8	10						1.7¶	600	1500	8			43
2N3564	TO-106	30	15	4	50	15	20	500	15	10	0.3		0.97	20		3.5¶	400	1200	15			43
2N3600	TO-72	30	15	3	10	15	20	150	3	1						1	850	1500	2	4.5	200	42
2N3662	TO-92(74)	18	12	3	500	15	20		8	10						1.7¶	700	2100	5	6.5	60	43
2N3663	TO-92(74)	30	12	3	500	15	20		8	10						1.7¶	700	2100	5	6.5	60	43
2N3693	TO-106	45	45	4	50	30	40	160	10	10						6¶	200		10			27
2N3694	TO-106	45	45	4	50	30	100	400	10	10						6¶	200		10			27
2N3825	TO-92(74)	30	15	4	100	15	20		2	10	0.25			2		3.5¶	200	800	2	5.5	1	43
2N3932	TO-72	30	20	2.5	10	15	40	150	2	8						0.55	750	1600	2	4.5	200	42
2N3933	TO-72	40	30	2.5	10	15	60	200	2	8						0.55	750	1600	2	4	200	42
2N4134	TO-72	30	30	3	50	10	25	200	4	10	3.0		0.92	10		0.5¶	350	800	4	5	60	44
2N4135	TO-72	30	30	3	50	10	25	200	4	10	3.0		0.92	10		0.5¶	425	800	4			44
2N4259	TO-72	40	30	2.5	10	15	60	250	2	8						0.55	750	1600	1.5	5	450	42
2N4292	TO-92(74)	30	15	3	500	15	20		3	1	0.6			10		3.5¶	600		4	6	60	43
2N4293	TO-92(74)	30	15	3	500	15	20		3	1	0.6			10		3.5¶	600		4	6	60	43
2N4934	TO-72(28)	40	30	3	10	15	40	170	2	8						0.25§	700	1600	2	3.5	200	47
2N4935	TO-72(28)	50	40	3	10	15	60	200	2	8						0.25§	700	1600	2	3.6	200	47
2N4936	TO-72(28)	50	40	3	10	15	60	250	2	8						0.25§	700	1600	2	4.5	450	47
2N5130	TO-106	30	12	1	50	10	15	250	8	10	0.6		1	10		1.7¶	450		8			43
2N5132	TO-106	20	20	3	50	10	30	400	10	10	0.2		0.9	10		3.5¶	200		10			27
2N5179	TO-72	20	12	2.5	20	15	25	250	3	1	0.4		1	10		1	900	2000	5	4.5	200	42
2N5180	TO-72	30	15	2	500	8	20	200	2	8						1	650	1700	2			42
2N5181	TO-72(28)				20	1	27		1	6						0.32	400	1200	3			47
2N5182	TO-72(28)				30	1	27		1	6						0.34	400	1200	3			47
2N5222	TO-92(71)	20	15	2	100	10	20	1500	4	10	1		1.2	4		1.3	450		4			49
2N5770	TO-92(72)	30	15	3	10	15	20		3	1	0.4		1	10		1.7	900		8	6	60	43
2SC313	TO-72	30	19	2	500	10	35	120	10	10	1			20		2¶	600					42
2SC454	TO-92(74)	30	30	5	500	18	60	320	2	12	1.1		0.75	10 2		3.5¶				25	1 kHz	23

*Electrically but not mechanically identical to Pro-Electron type numbers. ¶ C_{ob} § Typical

NPN Transistors

RF-IF AMPS AND OSCILLATORS (Cont.)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) @ V_{CB} (V) Max	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(sat)}$ (V) & $V_{BE(sat)}$ (V) Max	$V_{BE(sat)}$ (V) Min	$V_{BE(sat)}$ (V) Max	@ I_C (mA)	C_{cb}/C_{re} (pF) Min	C_{cb}/C_{re} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	NF (dB) Max	@ Freq (MHz)	Process No.
2SC458	TO-92(74)	30	30	5	500	18	60	500	2	12	1.0			10					10	1 kHz	23
												0.75	2	3.5¶							
2SC463	TO-72	35	35	4	100	10	30	150	2	10					0.6	400		2	4	200	44
2SC464	TO-72	30	19	2	500	10	20 (1 kHz)		1	6	1			20	2¶	600		10			42
2SC466	TO-72	30	19	2	500	10	20 (1 kHz)		1	6	1			20	2¶	600		10			42
2SC535	TO-92(74)	30	20	4	500	10	35	200	1	6					1.2¶	450		1	5.5	100	42
2SC562	TO-72(28)	40	30	4			40		4	10					0.22						45
2SC563	TO-72(28)	40	25	4			38		7	10					0.23						47
2SC682	TO-72	20	20	3	100	10	20	200	2	10					0.6¶	400		2			44
2SC683	TO-72	20	20	3	100	10	20	200	2	10					0.6¶	400		2	4	200	44
2SC684	TO-92(74)	30	19	2	500	10	40		10	10	1			20	2¶	900		10			42
2SC717	TO-92(74)	30	19	2	500	10	40		1	6	1			20	2¶	600		10			42
40235	TO-72	45		4.5	20 1 μA	1 35	40	170	1	6					0.65				3.3§	216	42
40236	TO-72	45		4.5	20 1 μA	1 35	40	275	1	6					0.65						42
40237	TO-72	45		4.5	20 1 μA	1 35	27	275	1	6											42
40238	TO-72	45		4.5	20 1 μA	1 35	40	170	1	6											42
40239	TO-72	45		4.5	20 1 μA	1 35	27	100	1	6											42
40240	TO-72	45		4.5	20 1 μA	1 35	27	275	1	6											42
40242	TO-72	45	45	4.5	20	1	40	170	1	6					0.65¶				2.5§	100	42
40243	TO-72	45	45	4.5	20	1	40	170	1	6					0.65¶						42
40244	TO-72	45	45	4.5	20	1	27	170	1	6					0.8¶						42
40245	TO-72	45	45	4.5	20	1	70	275	1	6					0.65¶						42
40246	TO-72	45	45	4.5	20	1	27	90	1	6					0.65¶						42
40472	TO-72(28)	45		3	20 1 μA	1 45	40	170	1	6					0.19§				3.3§	200	47
40473	TO-72(28)	45		3	20 1 μA	1 45	40	275	1	6					0.19§						47
40474	TO-72(28)	45		3	20 1 μA	1 45	27	275	1	6											47
40475	TO-72(28)	45		3	20 1 μA	1 45	40	170	1	6					0.18§						47
40476	TO-72(28)	45		3	20 1 μA	1 45	27	100	1	6					0.18§						47
40477	TO-72(28)	45		3	20 1 μA	1 45	27	275	1	6					0.18§						47

40478	TO-72(28)	45	45	3	20	1	40	170	1	6						0.2§			2.5§	100	47
40479	TO-72(28)	45	45	3	20	1	40	170	1	6						0.2§					47
40480	TO-72(28)	45	45	3	20	1	27	275	1	6						0.2§					47
40481	TO-72(28)	45	45	3	20	1	70	275	1	6						0.2§					47
40482	TO-72(28)	45	45	3	20	1	27	90	1	6						0.2§					47
BF167	TO-72(28)	40	30	4			27		4	10						0.15§			3§	35	45
BF173	TO-72(28)	40	25	4			38		7	10			0.9	7							47
BF194 (ST194)*	TO-92(71)	30	20	5			66	210	1	10		0.65	0.74	1		0.95§			4§ 1.2§ 1.5§	100 1 0.2	49
BF195 (ST195)*	TO-92(71)	30	20	5			35	125	1	10		0.65	0.74	1		0.95§			3.5§ 4§	1 100	49
BF196 (ST196)*	TO-92(71)	40	30	4			27		4	10			0.84	4					3§	35	45
BF197 (ST197)*	TO-92(71)	40	25	4			38		7	10			0.9	7							47
BF198 (ST198)*	TO-92(71)	40	30	4			27		4	10			0.85	4					3§	35	45
BF199 (ST199)*	TO-92(71)	40	25	4			38		7	10			0.925	7					1.5§ 1.2§	0.2 1	47
BF233	TO-92(71)	30	20	5			35	120	1	10						0.85§			2.5§	1	49
CS9010	TO-105		20	3	50	18	16	200	1	5	0.7		1	20							46
CS9011	TO-106		18	3	50	18	29	280	1	5											27
CS9016	TO-106		20	3	50	18	29	146	1	5	3		1	10							44
CS9017	TO-106		18	3	50	18	40	198	1	5	2		0.9	10							27
CS9018	TO-106		12	2	50	15	29	198	1	5	0.6			10							43
CS9019	TO-72		20	3	50	18	16	280	1	5	3	1	1	10							44
EN918	TO-106	30	15	3	50	15	20		3	1	0.4		1	10		3¶	600		4	6	60	43
MPS3563	TO-92(72)	30	15	2	50	15	20	200	8	10						1.7¶	600	1500	8			43
MPS3693	TO-92(72)	45	45	4	50	35	40	160	10	10						3.5¶	200		10	4	1	27
MPS3694	TO-92(72)	45	45	4	50	35	100	400	10	10						3.5¶	200		10	4	1	27
MPS6507	TO-92(72)	30 (V_{CES})	20		50	15	25		2	10						2.5¶	700		10			43
MPS6511	TO-92(72)	30 (V_{CES})	20		50	15	25		2	10						2.5¶						43
MPS6540	TO-92(71)	30	30	4	100	25	25		2	10	0.5		0.95	10		0.65	350		2			49
MPS6542	TO-92(71)	30 (V_{CES})	20		50	15	25		2	10						1.5¶	700		10			47
MPS6543	TO-92(71)	35	25	3	100	25	25		4	10	0.35		0.95	10		1¶	750		4			47
MPS6544	TO-92(71)	60	45	4	500	35	20		30	10	0.5			30		0.65						49
MPS6546	TO-92(71)	35	25	3	1 μA	25	20		2	10	0.35			10		0.45	600		2			47
MPS6567	TO-92(71)		40	5	500	35	25		10	5	0.5		0.8	10		0.7						49
MPS6568A	TO-92(71)	20	20	3	50	10	20	200	4	5	3		0.96	10		0.65	375	800	4	3.3	200	44
MPS6569	TO-92(71)	20	20	3	50	10	20	200	4	5	3		0.96	10		0.5	300	800	10	6	45	44
MPS6570	TO-92(71)	20	20	3	50	10	20	200	4	5	3		0.96	10		0.5	300	800	10	6	45	44
MPSH10	TO-92(71)	30	25	3	100	25	60		4	10	0.5		0.95	4		0.7	650		4			42
MPSH11	TO-92(71)	30	25	3	100	25	60		4	10	0.5		0.95	4		0.7	650		4			47

*Electrically but not mechanically identical to Pro-Electron type numbers. ¶ C_{ob} § Typical

RF-IF AMPS AND OSCILLATORS (Cont.)

NPN Transistors

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) @ V_{CB} (V) Max		h_{FE} Min	Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(sat)}$ (V) & $V_{BE(sat)}$ (V) @ I_C (mA) Max	Min	Max		C_{cb}/C_{re} (pF) Min	Max	f_T (MHz) @ I_C (mA) Min	Max		NF (dB) @ Freq (MHz) Max		Process No.
MPSH20	TO-92(71)	40	30	4	50	15	25		4	10						0.65	400		4			49
MPSH30	TO-92(71)	20	20	3	50	10	20	200	4	5	3		0.96	10		0.65	300	800	4	6	45	44
MPSH31	TO-92(71)	20	20	3	50	10	20	200	4	5	3		0.96	10		0.65	300	800	4	6	45	44
MPSH32	TO-92(71)	40	30	4	50	10	27	200	4	5	3		1.2	10		0.22	300		4			45
MPSH37	TO-92(71)		40	5	500	35	25		5	10	0.5		0.9	10 5		0.7	300		5			49
PE3100	TO-71(71)	30	30	3	200	30	30	225	5	10						0.85	500		5			47
PE5025	TO-92(72)	30	30	3	50	30	20	100	10	10	6			20	0.6	1.1	300	700	10			46
PE5029	TO-71(71)	30	30	3	200	30	30	225	5	10			0.85	5		0.4	500		5	6	45	47
PE5030	TO-92(71)	45	40	4.5	100	30	45	150	7	15	3		0.92	20 10	0.25	0.4	600		7			47
PE5031	TO-71(71)	40	30	4	100	30	30	180	5	10	1			10		0.4	500		5	4.5	200	47
PE5055	TO-92(71)	20	20	3	50	20	20	220	2	10	2			10		0.3	300		2	5	45	45
PN918	TO-92(72)	30	15	3	10	15	20		3	1	0.4		1	10		1.7¶	600		4	6	60	43
SE1001	TO-106	45	45	4	500	30	40	160	10	10						3.5¶	200		10			26
SE1002	TO-106	45	45	4	500	30	100	400	10	10						3.5¶	200		10			26
SE3001	TO-106	30	12	2	500	15	20		8	10	0.6			10		1.7¶	600		8	4	60	43
SE3002	TO-106	30	12	2	500	15	20		8	10	0.6			10		1.7¶	600		8	4	60	43
SE5020	TO-72	20	20	3	50	10	20	200	4	5	3		0.96	10	0.25	0.5	375	800	4	3.3	200	44
SE5021	TO-72	20	20	3	50	10	20	200	4	5	3		0.96	10	0.25	0.5	375	800	4	4	200	44
SE5022	TO-72	20	20	3	50	10	20	200	4	5	3		0.96	10	0.25	0.5	300	800	4			44
SE5023	TO-72	20	20	3	50	10	20	200	4	5	3		0.96	10	0.25	0.5	300	800	4	6	45	44
SE5024	TO-72	20	20	3	50	10	20	200	4	5	3		0.96	10	0.25	0.5	300	800	4	6	45	44
SE5035	TO-72(28)	40	30	4	50	30	40	180	5	10					0.25	0.30	600		5			47
SE5050	TO-72	20	20	3	50	10	20	200	4	5	3		0.96	10		0.5	300		4	4	100	44
SE5051	TO-72	20	20	3	50	10	20	200	4	5	3		0.96	10	0.25	0.5	300		4	3†	100	44
SE5052	TO-72	20	20	3	50	10					3			10	0.25		375		4	4	200	44
SE5055	TO-72(28)	20	20	3	50	20	20	220	2	10	2			10		0.22	300		2	5	200	45

*Electrically but not mechanically identical to Pro-Electron type numbers. ¶ C_{ob} § Typical

LOW LEVEL AMPS

NPN Transistors

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) @ V_{CB} (V) Max		h_{FE} h_{fe} (1kc)* Min	Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(sat)}$ (V) & $V_{BE(sat)}$ (V) @ I_C (mA) Max	Min	Max		C_{ob} (pF) Max	f_T (MHz) @ I_C (mA) Min	Max		t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
2N759	TO-18	45	45	8	200	30	36	90*	1	5	1	0.6	1.1	10	8	50		1				07
2N760	TO-18	45	45	8	200	30	76	333*	1	5	1	0.6	1.1	10	8	50		1				07
2N760A	TO-18	60	60	8	100	30	76	333*	1	5	1	0.9	1.1	10	8	50		1				07

JAN2N760A	TO-18	75	60	8	10	30	76	333*	1	5	1	0.6	1.1	10	6	60		1		24	1	07
2N916	TO-18	45	25	5	10	30	50	200	10	1	0.5		0.9	10	6	300		10				23
2N929	TO-18	45	45	4	10	45	40	120	0.01μA	5	1	0.6	1.1	10	8	30		0.5		4	5	07
							60		0.5μA	5											
								350	10	5											
JAN2N929	TO-18	60	45	6	10	45	40	120	0.01μA	5	1	0.6	1.1	10	8	45	180	0.5		5	3	07
							60		0.5μA	5										3	4	
								350	10	5										3	2	
JANTX2N929	TO-18	65	45	6	10	45	40	120	0.01	5	1	0.6	1	10	8	45	180	0.5		5	3	07
							60		0.5	5										3	4	
								350	10	5										3	2	
JANTXV2N929	TO-18	65	45	6	10	45	40	120	0.01	5	1	0.6	1	10	8	45	180	0.5		5	3	07
							60		0.05	5										3	4	
								350	10	5										3	2	
2N929A	TO-18	60	45	6	2	45	25		0.001	5	0.5	0.7	0.9	10	6	45		0.5		4	2	07
							40	120	0.01	5												
							60		0.5	5												
								350	10	5												
2N930	TO-18	45	45	5	10	45	100	300	0.01	5	1	0.6	1	10	8	30		0.5		3	5	07
							150		0.5	5												
								600	10	5												
JAN2N930	TO-18	60	45	6	10	45	100	300	0.01	5	1	0.6	1	10	8	45	180	0.5		5	3	07
							150		0.5	5										3	4	
								600	10	5										3	2	
JANTX2N930	TO-18	60	45	6	10	45	100	300	0.01	5	1	0.6	1	10	8	45	180	0.5		5	3	07
							150		0.5	5										3	4	
								600	10	5										3	2	
JANTXV2N930	TO-18	60	45	6	10	45	100	300	0.01	5	1	0.6	1	10	8	45	180	0.5		5	3	07
							150		0.5	5										3	4	
								600	10	5										3	2	
2N930A	TO-18	60	45	6	2	45	60		0.001	5	0.5	0.7	0.9	10	6	45		0.5		3	2	07
							100	300	0.01	5												
							150		0.5	5												
								600	10	5												
2N981	TO-18	80	80	8	1μA	30	36	100*	1	5	3			10	5							07
2N2483	TO-18	60	60	6	10	45	40	120	0.01	5	0.35	0.5	0.7	1	6	60		0.5		4	4	07
							75		0.1	5										3	2	
							175		1	5										4	5	
2N2484	TO-18	60	60	6	10	45	100	500	0.01	5	0.35	0.5	0.7	1	6	60		0.5		3	4	07
							175		0.1	5										2	2	
							250		1	5										3	5	
2N2509	TO-18	125	80	7	5	100	25		0.01	5	1		0.9	5	6	45		5		7	4	07
							40		10	5												
2N2510	TO-18	100	65	7	5	80	75		0.01	5	1		0.9	5	6	45		5		4	4	07
							150	500	10	5												
2N2511	TO-18	80	50	7	5	60	80		0.001	5	1		0.9	5	6	45		5		4	4	07
							120		0.01	5												
							240	750	10	5												
2N2586	TO-18	60	45	6	2	45	80		0.001	5	0.5	0.7	0.9	10	7	45		0.5		3	4	07
							120	360	0.01	5										2	2	
							150		0.5	5												
								600	10	5												

Test Conditions:

1. I_C = 1.0 mA, V_{CB} = 5.0V, R_G = 500Ω, f = 1.0 kHz
2. I_C = 10μA, V_{CE} = 5.0V, R_G = 10 kΩ, f = 10 kHz
3. I_C = 10μA, V_{CE} = 5.0V, R_G = 10 kΩ, f = 100 Hz
4. I_C = 10μA, V_{CE} = 5.0V, R_G = 10 kΩ, f = 1.0 kHz
5. I_C = 10μA, V_{CE} = 5.0V, R_G = 10 kΩ, BW = 15.7 kHz
6. I_C = 5.0μA, V_{CE} = 5.0V R_G = 50 kΩ, f = 1.0 kHz
7. I_C = 5.0μA, V_{CE} = 5.0V, R_G = 50 kΩ, f = 10 kHz
8. V_{CE} = 5.0V, I_C = 100μA, R_G = 10 kΩ, W.B.
9. V_{CE} = 5.0V, I_C = 30μA, R_G = 100 kΩ, f = 1.0 kHz
10. I_C = 20μA, V_{CE} = 5.0V, R_S = 22 kΩ, W.B.
11. I_C = 20μA, V_{CE} = 5.0V, R_S = 10 kΩ, f = 1.0 kHz
12. I_C = 100μA, V_{CE} = 5.0V, R_G = 5.0 kΩ, W.B.
13. I_C = 100μA, V_{CE} = 4.5V, R_G = 5.0 kΩ, W.B.

NPN Transistors

LOW LEVEL AMPS (Cont.)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) @ V_{CB} (V) Max		h_{FE} h_{fe} (1kc)* Min	Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max	& $V_{BE(sat)}$ (V) Min	Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
2N3117	TO-18	60	60	6	10	45	250	500	0.01	5	0.35		0.7	1	8	60		0.5		1	6	07
							300		0.1	5										1	7	
							400		1	5												
2N3565	TO-106	30	25	6	50	25	150	600	1	10					4	40	240	1				07
2N3691	TO-106	35	20	4	50	15	40	160	10	1	0.7		0.9	10	3.5	200		10				23
2N3692	TO-106	35	20	4	50	15	100	400	10	1	0.7		0.9	10	3.5	200		10				23
2N3707	TO-92(74)	30	30	6	100	20	100	400	0.1	5	1			10						5	12	07
2N3708	TO-92(74)	30	30	6	100	20	45	660	1	5	1			10								07
2N3709	TO-92(74)		30		100	20	45	165	1	5	1			10								07
2N3710	TO-92(74)	30	30	6	100	20	90	330	1	5	1			10								07
2N3711	TO-92(74)	30	30	6	100	20	180	660	1	5	1			10								07
2N3877	TO-92(74)	70	70	4	500	70	20	250	2	4.5		0.5	0.9	10								07
2N3877A	TO-92(74)	85	85	4	500	70	20	250	2	4.5		0.5	0.9	10								07
2N3900	TO-92(74)	18	18	5	100	18	250	500	2	4.5					12							07
2N3900A	TO-92(74)	18	18	5	100	18	250	500	2	4.5					12					5	13	07
2N3901	TO-92(74)	18	18	5	100	18	350	700	2	4.5										5	13	07
2N4286	TO-92(74)	30	25	6	50	25	100		0.1	5	0.35		0.8	1	6	40		1				07
							150	600	1	5												
2N4287	TO-92(74)	45	45	7	10	30	100		0.1	5	0.35		0.8	1	6	40		1		5	5	07
							150	600	1	5												
2N4384	TO-18	40	30	5	10	30	60		0.001	5	0.2	0.65	0.8	10	8	30	120	0 5		2	5	07
							100	500	0.01	5												
							120		1	5												
							150		10	5												
2N4386	TO-18	40	30	5	10	30	40	500	0.01	5	0.2	0.65	0.8	10	8	30	120	0.5		3	5	07
							100		1	5												
							120		10	5												
2N4409	TO-92(72)	80	50	5	10	60	60		1	1	0.2		0.8	1	12	60	300	10				07
							60	400	10	1												
2N4410	TO-92(72)	120	80	5	10	100	60		1	1	0.2		0.8	1	12	60	300	10				07
							60	400	10	1												
2N4966	TO-106	50	40	6	25	25	40	200	0.01	5	0.4				6	40		1		6	4	07
							50		10	5												
2N4967	TO-106	50	40	6	25	25	100	600	0.01	5	0.4				6	40		1		6	4	07
							120		10	5												
2N4968	TO-106	30	25	6	50	25	40	200	0.01	5	0.4				6	40		1		6	4	07
							50		10	5												
2N5088	TO-92(72)	35	30		50	20	300	900	0.1	5	0.5		10	4						3	8	07
							350		1	5												
							300		10	5												
2N5089	TO-92(72)	35	30		50	15	400	120	0.1	5	0.5			10	4					3	8	07
							450		1	5												
							400		10	5												
2N5127	TO-106	20	12	3	50	10	15	300	2	10	0.3				3.5	150		2				27
2N5131	TO-106	20	15	3	50	10	30	500	10	10	1				6	100		10				27

2N5133	TO-106	20	18	3	50	15	60	1000	1	1	0.4				5	40	200	1				07
2N5209	TO-92(72)	50	50		50	35	100	300	0.1	5	0.7			10	4	30		0.5		3	10	07
							150		1	5										4	11	
							150		10	5												
2N5210	TO-92(72)	50	50		50	35	200	600	0.1	5	0.7			10	4	30		0.5		2	10	07
							250		1	5										3	11	
							250		10	5												
2N5232	TO-92(74)		50		30	50	250	500	2	5	0.125			10	4							07
2N5232A	TO-92(74)		50		30	50	250	500	2	5	0.125			10	4					5	12	07
EN930	TO-106	45	45	5	50	45	100	300	0.01	5	1	0.6	1	10	8	30		0.5		3	5	07
							150		0.5	5												
								600	10	5												
EN2484	TO-106	60	60	6	50	45	30		0.001	5	0.35	0.5	0.7	1	6	60		0.5		3	5	07
							100	500	0.01	5										3	4	
							175		0.1	5										2	2	
							200		0.5	5												
							250		1	5												
								800	10	5												
MPSA09	TO-92(72)	50	50		100	25	100	600	0.1	5	0.9			10		30		0.5				07
MPS3707	TO-92(74)	30	30	6	100	20	100	400	0.1	5	1			10						5	12	07
MPS3708	TO-92(74)	30	30	6	100	20	45	660	1	5	1			10								07
MPS3709	TO-92(74)	30	30	6	100	20	45	165	1	5	1			10								07
MPS3710	TO-92(74)	30	30	6	100	20	90	330	1	5	1			10								07
MPS3711	TO-92(74)	30	30	6	100	20	180	660	1	5	1			10								07
MPS6571	TO-92(74)	25	20	3	50	20	250	1000	0.1	5	0.5			10	4.5	50		0.5				07
PN930	TO-92(72)	45	45	5	10	45	100	300	0.01	5	1	0.6	1.0	10	8	30		0.5		3	5	07
							150		0.5	5												
								600	10	5												
PN2484	TO-92(72)	60	60	6	10	45	30		0.001	5	0.35			1	6							07
							100	500	0.01	5												
							175		0.1	5												
							200		0.5	5												
							250		1	5												
								800	10	5												
SE4001	TO-106	30	25	6	200	5	60	300	1	10	0.35			1	4	40		1				07
SE4002	TO-106	30	25	6	200	5	200	1000	1	10	0.35			1	4	60		1				07
SE4010	TO-106	30	25	6	200	5	200	1000	1	10	0.35			1	4	20		0.05		3	9	07
																60		1				

Test Conditions:

1. I_C = 1.0 mA, V_{CB} = 5.0V, R_G = 500Ω, f = 1.0 kHz
2. I_C = 10μA, V_{CE} = 5.0V, R_G = 10 kΩ, f = 10 kHz
3. I_C = 10μA, V_{CE} = 5.0V, R_G = 10 kΩ, f = 100 Hz
4. I_C = 10μA, V_{CE} = 5.0V, R_G = 10 kΩ, f = 1.0 kHz
5. I_C = 10μA, V_{CE} = 5.0V, R_G = 10 kΩ, BW = 15.7 kHz
6. I_C = 5.0μA, V_{CE} = 5.0V R_G = 50 kΩ, f = 1.0 kHz
7. I_C = 5.0μA, V_{CE} = 5.0V, R_G = 50 kΩ, f = 10 kHz
8. V_{CE} = 5.0V, I_C = 100μA, R_G = 10 kΩ, W.B.
9. V_{CE} = 5.0V, I_C = 30μA, R_G = 100 kΩ, f = 1.0 kHz
10. I_C = 20μA, V_{CE} = 5.0V, R_S = 22 kΩ, W.B.
11. I_C = 20μA, V_{CE} = 5.0V, R_S = 10 kΩ, f = 1.0 kHz
12. I_C = 100μA, V_{CE} = 5.0V, R_G = 5.0 kΩ, W.B.
13. I_C = 100μA, V_{CE} = 4.5V, R_G = 5.0 kΩ, W.B.

NPN Transistors

GENERAL PURPOSE AMPS AND SWITCHES

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) @ V_{CB} (V) Max		h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max	& $V_{BE(sat)}$ (V) Min	Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
2N697	TO-5	60	40	5	100	30	40	120	150	10	1.5		1.3	150	35	50		50				20
2N699	TO-39	120		5	2	60	40	120	150	10	5		1.3	150	20	50		50				12
2N718	TO-18	60	40	5	100	30	40	120	150	10	1.5		1.3	150	35	50		15				20

NPN Transistors

GENERAL PURPOSE AMPS AND SWITCHES (Cont.)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) @ V_{CB} (V) Max		h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max	& $V_{BE(sat)}$ (V) Min	Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
2N915	TO-18	70	50	5	10	60	50	20	10	5	1		0.9	10	3.5	250		10				23
2N956	TO-18	75		7	10	60	20		0.01	10	1.5		1.3	150	25	70		50				20
							75		10	10												
							100	300	150	10												
							40		500	10												
2N1420	TO-5	60		5	1 μA	30	100	300	150	10	1.5		1.3	150	35	50		50				20
2N1566	TO-5	80	60	5	1 μA	40	60*		1	5	1			10	10							20
							80*	200	5	5												
2N1613	TO-5	75	50	7	10	60	20		0.1	10	1.5		1.3	150	25	60		50		12	5	20
							35		10	10												
							40	120	150	10												
							20		500	10												
2N1711	TO-5	75		7	100	60	20		0.01	10	1.5		1.3	150	25	70		50				20
							75		10	10												
							100	300	150	10												
							40		500	10												
2N2218	TO-5	60	30	5	10	50	20		0.1	10	0.4		1.3	150	8	250		20				20
							35		10	10	1.6		2.6	500								
							40	120	150	10												
							20		500	10												
JAN2N2218	TO-5	60	30	5	10	50	20		0.1	10	0.4	0.6	1.3	150	8	250		20	250		1	20
							25		1	10	1.6		2.6	500								
							35		10	10												
							40	120	150	10												
							20		500	10												
JANTX2N2218	TO-5	60	30	5	10	50	20		0.1	10	0.4	0.6	1.3	150	8	250		20	250		1	20
							35		10	10	1.6		2.6	500								
							40	120	150	10												
							20		500	10												
JANTXV2N2218	TO-5	60	30	5	10	50	20		0.1	10	0.4	0.6	1.3	150	8	250		20	250		1	20
							35		10	10	1.6		2.6	500								
							40	120	150	10												
							20		500	10												
2N2218A	TO-5	75	40	6	10	60	20		0.1	10	0.3	0.6	1.2	150	8	250		20	285†		1	20
							35		10	10	1		2	500								
							40	120	150	10												
							20		150	1												
							25		500	10												
JAN2N2218A	TO-5	75	50	6	10	60	30		0.1	10	0.3	0.6	1.2	150	8	250		20	300		1	20
							35		1	10	1		2	500								
							40		10	10												
							40	120	150	10												
							20		500	10												
JANTX2N2218A	TO-5	75	50	6	10	60	30		0.1	10	0.3	0.6	1.2	150	8	250		20	300		1	20
							40		10	10	1		2	500								
							40	120	150	10												
							20		500	10												
JANTXV2N2218A	TO-5	75	50	6	10	60	30		0.1	10	0.3	0.6	1.2	150	8	250		20	300		1	20
							40		10	10	1		2	500								
							40	120	150	10												
							20		500	10												

2N2219	TO-5	60	30	5	10	50	35		0.1	10	0.4		1.3	150	8	250	20			1	20
							75		10	10	1.6		2.6	500							
							100	300	150	10											
							30		500	10											
JAN2N2219	TO-5	60	30	5	10	50	35		0.1	10	0.4	0.6	1.3	150	8	250	20	250		1	20
							50		1	10	1.6		2.6	500							
							75		10	10											
							100	300	150	10											
							30		500	10											
JANTX2N2219	TO-5	60	30	5	10	50	35		0.1	10	0.4	0.6	1.3	150	8	250	20	250		1	20
							75		10	10	1.6		2.6	500							
							100	300	150	10											
							30		500	10											
JANTXV2N2219	TO-5	60	30	5	10	50	35		0.1	10	0.4	0.6	1.3	150	8	250	20	250		1	20
							75		10	10	1.6		2.6	500							
							100	300	150	10											
							30		500	10											
2N2219A	TO-5	75	40	6	10	60	35		0.1	10	0.3	0.6	1.2	150	8	300	20	285†		1	20
							75		10	10	1		2	500							
							100	300	150	10											
							50		150	1											
							40		500	10											
JAN2N2219A	TO-5	75	50	6	10	60	50		0.1	10	1		2	500	8	250	20	300		1	20
							75		1	10	0.3	0.6	1.2	150							
							100		10	10											
							100	300	150	10											
							30		500	10											
JANTX2N2219A	TO-5	75	50	6	10	60	50		0.1	10	0.3	0.6	1.2	150	8	250	20	300		1	20
							100		10	10	1		2	500							
							100	300	150	10											
							30		500	10											
JANTXV2N2219A	TO-5	75	50	6	10	60	50		0.1	10	0.3	0.6	1.2	150	8	250	20	300		1	20
							100		10	10	1		2	500							
							100	300	150	10											
							30		500	10											
2N2221	TO-18	60	30	5	10	50	20		0.1	10	0.4		1.3	150	8	250	20				20
							35		10	10	1.6		2.6	500							
							40	120	150	10											
							20		500	10											
JAN2N2221	TO-18	60	30	5	10	50	20		0.1	10	0.4	0.6	1.3	150	8	250	20	250		1	20
							25		1	10	1.6		2.6	500							
							35		10	10											
							40	120	150	10											
							20		500	10											
JANTX2N2221	TO-18	60	30	5	10	50	20		0.1	10	0.4	0.6	1.3	150	8	250	20	250		1	20
							35		10	10	1.6		2.6	500							
							40	120	150	10											
							20		500	10											
JANTXV2N2221	TO-18	60	30	6	10	50	20		0.1	10	0.4	0.6	1.3	150	8	250	20	250		1	20
							35		10	10	1.6		2.6	500							
							40	120	150	10											
							20		500	10											
2N2221A	TO-18	75	40	6	10	60	30		0.1	10	0.3	0.6	1.2	150	8	250	20	285†		1	20
							35		10	10	1		2	500							
							40	120	150	10											
							20		150	1											
							25		500	10											

Test Conditions

1. I_C = 150 mA, V_{CC} = 30V, $I_{B1} = I_{B2}$ = 15 mA
2. I_C = 100μA, V_{CE} = 5.0V, R_G = 1.0 kΩ, BW = 15.7 kHz
3. I_C = 10μA, V_{CE} = 5.0V, R_G = 10 kΩ, W.B.
4. V_{CC} = 3.0V, I_C = 10 mA, $I_{B1} = I_{B2}$ = 1.0 mA
5. I_C = 300μA, V_{CE} = 10V, R_G = 510Ω, f = 1.0 kHz
6. V_{CE} = 4.5V, I_C = 100μA, R_G = 500Ω, B_W = 15.7 kHz
7. V_{CC} = 6.0V, I_C = 150 mA, $I_{B1} = I_{B2}$ = 15 mA

*$V_{BE(ON)}$

**Metal Can equivalents of 2N3903 and 2N3904

($t = t_s + t_f$)

NPN Transistors

GENERAL PURPOSE AMPS AND SWITCHES (Cont.)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) @ V_{CB} (V) Max		h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max	& $V_{BE(sat)}$ (V) Min	(V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
JAN2N2221A	TO-18	75	50	6	10	60	30		0.1	10	0.3	0.6	1.2	150	8	250		20	300		1	20
							35		1	10	1		2	500								
							40		10	10												
							40	120	150	10												
							20		500	10												
JANTX2N2221A	TO-18	75	50	6	10	60	30		0.1	10	0.3	0.6	1.2	150	8	250		20	300		1	20
							40		10	10	1		2	500								
							40	120	150	10												
							20		500	10												
JANTXV2N2221A	TO-18	75	50	6	10	60	30		0.1	10	0.3	0.6	1.2	150	8	250		20	300		1	20
							40		10	10	1		2	500								
							40	120	150	10												
							20		500	10												
2N2222	TO-18	60	30	5	10	50	35		0.1	10	0.4		1.3	150	8	250		20				20
							75		10	10	1.6		2.6	500								
							100	300	150	10												
							30		500	10												
JAN2N2222	TO-18	60	30	5	10	50	35		0.1	10	0.4	0.6	1.3	150	8	250		20	250		1	20
							50		1	10	1.6		2.6	500								
							75		10	10												
							100	300	150	10												
							30		500	10												
JANTX2N2222	TO-18	60	30	5	10	50	35		0.1	10	0.4	0.6	1.3	150	8	250		20	250		1	20
							75		10	10	1.6		2.6	500								
							100	300	150	10												
							30		500	10												
JANTXV2N2222	TO-18	60	30	6	10	50	35		0.1	10	0.4	0.6	1.3	150	8	250		20	250		1	20
							75		10	10	1.6		2.6	500								
							100	300	150	10												
							30		500	10												
2N2222A	TO-18	75	40	6	10	60	35		0.1	10	0.3	0.6	1.2	150	8	300		20	285†		1	20
							75		10	10	1		2	500								
							100	300	150	10												
							50		150	1												
							40		500	10												
JAN2N2222A	TO-18	75	50	6	10	60	50		0.1	10	0.3	0.6	1.2	150	8	250		20	300		1	20
							75		1	10	1		2	500								
							100		10	10												
							100	300	150	10												
							30		500	10												
JANTX2N2222A	TO-18	75	50	6	10	60	50		0.1	10	0.3	0.6	1.2	150	8	250		20	300		1	20
							100		10	10	1		2	500								
							100	300	150	10												
							30		500	10												
JANTXV2N2222A	TO-18	75	50	6	10	60	50		0.1	10	0.3	0.6	1.2	150	8	250		20	300		1	20
							100		10	10	1		2	500								
							100	300	150	10												
							30		500	10												
2N2712	TO-92(74)	18	18	5	500	18	75	225	2	4.5					12							27
2N2714	TO-92(74)	18	18	5	500	18	75	225	2	4.5	0.3	0.6	1.3	50								27
2N2923	TO-92(74)	25	25	5	500	25	90*	180	2	10					12							04
2N2924	TO-92(74)	25	25	5	500	25	150*	300	2	10					12							04

2N2925	TO-92(74)	25	25	5	500	25	235*	470	2	10					12							04
2N2926	TO-92(74)	18	18	5	500	18	35*	470	2	10					12							04
2N3115	TO-18	60	20	5	25	50	40	120	150	10	0.5		1.3	150	8	250		20	500†		6	20
2N3116	TO-18	60	20	5	25	50	100	300	150	10	0.5		1.3	150	8	250		20	500†		6	20
2N3299	TO-5	60	30	5			20		0.1	10	0.22		1.1	150	8	250		50	300		1	20
							35		10	10	0.6		1.5	500								
							40	120	150	10	0.45		1.3	300								
							20		500	10												
2N3300	TO-5	60	30	5			35		0.1	10	0.22		1.1	150	8	250		50				20
							75		10	10	0.6		1.5	500								
							100	300	150	10	0.45		1.3	300								
							50		500	10												
2N3301	TO-18	60	30	5			20		0.1	10	0.22		1.1	150	8	250		50				20
							35		10	10	0.6		1.5	500								
							40	120	150	10	0.45		1.3	300								
							20		500	10												
2N3302	TO-18	60	30	5			35		0.1	10	0.22		1.1	150	8	250		50				20
							75		10	10	0.6		1.5	500								
							100	300	150	10	0.45		1.3	300								
							50		500	10												
2N3390	TO-92(74)	25	25	5	100	18	400	800	2	4.5					10							04
2N3391	TO-92(74)	25	25	5	100	18	250	500	2	4.5					10							04
2N3391A	TO-92(74)	25	25	5	100	18	250	500	2	4.5					10					5	7	04
2N3392	TO-92(74)	25	25	5	100	18	150	300	2	4.5					10							04
2N3393	TO-92(74)	25	25	5	100	18	90	180	2	4.5					10							04
2N3394	TO-92(74)	25	25	5	100	18	55	110	2	4.5					10							04
2N3395	TO-92(74)	25	25	5	100	18	150	500	2	4.5					10							04
2N3396	TO-92(74)	25	25	5	100	18	90	500	2	4.5					10							04
2N3397	TO-92(74)	25	25	5	100	18	55	500	2	4.5					10							04
2N3398	TO-92(74)	25	25	5	100	18	55	800	2	4.5					10							04
2N3414	TO-92(74)	25	25	5	100	25	75	225	2	4.5	0.3	0.6	1.3	50								19
2N3415	TO-92(74)	25	25	5	100	25	180	540	2	4.5	0.3	0.6	1.3	50								19
2N3416	TO-92(74)	50	30	5	100	25	75	225	2	4.5	0.3	0.6	1.3	50								19
2N3417	TO-92(74)	50	30	5	100	25	180	540	2	4.5	0.3	0.6	1.3	50								27
2N3566	TO-105	40	30	5	50	20	80		2	10	1			100	25	40	200	30				20
							150	600	10	10												
2N3641	TO-105	60	30	5	50	50	40	120	150	10	0.22			150	8	250		50				20
							15		500	10												
2N3642	TO-105	60	45	5	50	50	40	120	150	10	0.22			150	8	250		50				20
							15		500	10												
2N3643	TO-105	60	30	5	50	50	100	300	150	10	0.22			150	8	250		50				20
							20		500	10												
2N3678	TO-5	75	55	6	10	60	20		0.1	10	0.4	0.6	1.2	150					250†		6	20
							25		1	10	1		2	500								
							35		10	10												
							40	120	150	10												
							25		500	10												
							20		150	1												
2N3704	TO-92(74)	50	30	5	100	20	100	300	50	2	0.6			100	12	100		50				13
2N3705	TO-92(74)	50	30	5	100	20	50	150	50	2	0.8			100	12	100		50				13

Test Conditions

1. I_C = 150 mA, V_{CC} = 30V, $I_{B1} = I_{B2}$ = 15 mA
2. I_C = 100μA, V_{CE} = 5.0V, R_G = 1.0 kΩ, BW = 15.7 kHz
3. I_C = 10μA, V_{CE} = 5.0V, R_G = 10 kΩ, W.B.
4. V_{CC} = 3.0V, I_C = 10 mA, $I_{B1} = I_{B2}$ = 1.0 mA
5. I_C = 300μA, V_{CE} = 10V, R_G = 510Ω, f = 1.0 kHz
6. V_{CE} = 4.5V, I_C = 100μA, R_G = 500Ω, B_W = 15.7 kHz
7. V_{CC} = 6.0V, I_C = 150 mA, $I_{B1} = I_{B2}$ = 15 mA

*$V_{BE(ON)}$

**Metal Can equivalents of 2N3903 and 2N3904

($t = t_s + t_f$)

NPN Transistors

GENERAL PURPOSE AMPS AND SWITCHES (Cont.)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) @ V_{CB} (V) Max	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max	& $V_{BE(sat)}$ (V) Min	$V_{BE(sat)}$ (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
2N3706	TO-92(74)	40	20	5	100 @ 20	30	600	50	2	1			100	12	100		50				13
2N3721	TO-92(74)	18	18	5	500 @ 18	60*	660	2	10					12							27
2N3793	TO-92(74)	40	20	5	500 @ 15	10		0.1	10	0.4		1.5	10	10	100		10				13
						20	120	10	10												
						20		100	10												
2N3794	TO-92(74)	40	20	5	500 @ 15	35		0.1	10	0.4		1.5	10	10	100	600	10				13
						100	600	10	10												
						100		100	10												
2N3827	TO-92(74)	60	45	4	100 @ 30	100	400	10	10					3.5	200	800	10				27
2N3858	TO-92(74)	30	30	4	500 @ 18	60	120	2	4.5					4	90		2				27
2N3858A	TO-92(74)	60	60	6	500 @ 18	45		1	1					4	90		2				27
						60	120	10	1												
2N3859	TO-92(74)	30	30	4	500 @ 18	100	200	2	4.5					4	90		2				27
2N3859A	TO-92(74)	60	60	6	500 @ 18	75		1	1					4	90		2				27
						100	200	10	1												
2N3860	TO-92(74)	30	30	4	500 @ 18	150	300	2	4.5					4	90		2				27
2N3903	TO-92(72)	60	40	6	50 @ 30	20		0.1	1	0.2	0.65	0.85	10	4	250		10		6	2	23
					I_{CEX}	35		1	1	0.3		0.95	50					225†		4	
						50	150	10	1												
						30		10	1												
						15		100	1												
2N3904	TO-92(74)	60	40	6	50 @ 30	40		0.1	1	0.2	0.65	0.85	10	4	300		10		5	2	23
					I_{CEX}	70		1	1	0.3		0.95	50					250†		4	
						100	300	10	1												
						60		50	1												
						30		100	1												
2N3946	TO-18	60	40	6	10 @ 40	30		0.1	1	0.2	0.6	0.9	10	4	250		10		5	2	23
					I_{CEX}	45		1	1	0.3		1	50					375†		4	
						20		50	1												
2N3947	TO-18	60	40	6	10 @ 40	60		0.1	1	0.2	0.6	0.9	10	4	300		10		5	2	23
					I_{CEX}	90		1	1	0.3		1	50					450†		4	
						100		10	1												
						40		50	1												
2N4123	TO-92(72)	40	30	5	50 @ 20	50	150	2	1	0.3		0.95	50	4	250		10		6	2	23
						25		50	1												
2N4124	TO-92(72)	30	25	5	50 @ 20	120	360	2	1	0.3		0.95	50	4	300		10		5	2	23
						60		50	1												
2N4140	TO-106	60	30	5	50 @ 40	20		0.1	10	0.4		1.3	150	8	250		20				20
						25		1	10												
						35		10	10												
						20		150	1												
						40	120	150	10												
						20		500	10												
2N4141	TO-106	60	30	5	50 @ 40	35		0.1	10	0.4		1.3	150	8	250		20				20
						50		1	10												
						75		10	10												
						50		150	1												
						100	300	150	10												
						30		500	10												

2N4227	TO-106	60	30	5	50	40	25		0.1	10	0.4		1.3	150	8	250		20				20
							35		1	10												
							50		10	10												
							30		150	1												
							75	150	150	10												
							20		500	10												
2N4400	TO-92(72)	60	40	6			20		1	1	0.4	0.75	0.95	150		200		20	255†		1	13
							40		10	1	0.75		1.2	500								
							50	150	150	1												
							20		500	2												
2N4401	TO-92(72)	60	40	6			20		0.1	1						250		20	255†		1	13
							40		1	1												
							80		10	1												
							100	300	150	1												
							40		500	2												
2N4424	TO-92(74)	40	40	5	100	25	180	540	2	4.5	0.3	0.6	1.3	50								19
2N4944	TO-106	80	40	5	50	40	40	120	150	1	0.25			150	25	60	600	50				20
							40		30	1												
2N4945	TO-106	80	60	5	50	40	40	120	150	1	0.25			150	20	60	600	50				20
							40		30	1												
2N4946	TO-106	80	40	5	50	40	100	300	150	1	0.25			150	25	60	700	50				20
							100		30	1												
2N4951	TO-92(74)	60	30	5	50	40	20		1	10	0.3		1.3	150	8	250		20	400		1	13
							40		10	10												
							60	200	150	10												
2N4952	TO-92(74)	60	30	5	50	40	50		1	10	0.3		1.3	150	8	250		20	400		1	13
							75		10	10												
							100	300	150	10												
2N4953	TO-92(74)	60	30	5	50	40	75		1	10	0.3		1.3	150	8	250		20	400		1	13
							150		10	10												
							200	600	150	10												
2N4954	TO-92(74)	40	30	5	50	40	20		1	10	0.3		1.3	150	8	250		20	400		1	13
							40		10	10												
							60	600	150	10												
2N4969	TO-106	50	30	5	50	30	30		10	10	0.4	0.6	1.2	150	8	200		20				20
							40	120	150	10												
							20		150	1												
2N4970	TO-106	50	30	5	50	30	70		10	10	0.4	0.6	1.2	150	8	200		20				20
							100	350	150	10												
							50		150	1												
2N5128	TO-105	15	12	3	50	10	20		10	10	0.25		1.1	150	10	200	800	50				20
							35	350	50	10												
2N5129	TO-106	15	12	3	50	10	20		10	10	0.25		1.1	150	10	200	800	50				20
							35	350	50	10												
2N5135	TO-105	30	25	4	300	15	15		2	10	1		1	100	25	40	300	30				20
							50	600	10	10												
2N5136	TO-105	30	20	3	100	20	20		30	1	0.25		1.1	150	35	40	400	50				20
							20	400	150	1												
2N5137	TO-106	30	20	3	100	20	20		30	1	0.25		1.1	150	35	40	400	50				20
							20	400	150	1												
2N5172	TO-92(74)	25	25	5	100	25	100	500	10	10	0.25			10	10							27
2N5219	TO-92(72)	20	15	3	100	10	35	500	2	10	0.4		1	10	4	150		10				27
2N5220	TO-92(72)	15	15	3	100	10	25		10	10	0.5		1.1	150	10	100		20				13
							30	600	50	10												

Test Conditions

1. I_C = 150 mA, V_{CC} = 30V, $I_{B1} = I_{B2}$ = 15 mA
2. I_C = 100μA, V_{CE} = 5.0V, R_G = 1.0 kΩ, BW = 15.7 kHz
3. I_C = 10μA, V_{CE} = 5.0V, R_G = 10 kΩ, W.B.
4. V_{CC} = 3.0V, I_C = 10 mA, $I_{B1} = I_{B2}$ = 1.0 mA
5. I_C = 300μA, V_{CE} = 10V, R_G = 510Ω, f = 1.0 kHz
6. V_{CE} = 4.5V, I_C = 100μA, R_G = 500Ω, B_W = 15.7 kHz
7. V_{CC} = 6.0V, I_C = 150 mA, $I_{B1} = I_{B2}$ = 15 mA

*$V_{BE(ON)}$

**Metal Can equivalents of 2N3903 and 2N3904

($t = t_s + t_f$)

NPN Transistors

GENERAL PURPOSE AMPS AND SWITCHES (Cont.)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) @ V_{CB} (V) Max		h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max	& $V_{BE(sat)}$ (V) Min	$V_{BE(sat)}$ (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
2N5223	TO-92(72)	25	20	3	100	10	50	800	2	10	0.7		1.2	10	4	150		10				27
2N5225	TO-92(72)	25	25	4	300	15	25		10	10	0.8		1	100	20	50		20				13
							30	600	50	10												
EN697	TO-105	60	30	5	1000	30	40	120	150	10	1.5		1.3	150	35	50		30				20
EN916	TO-106	45	25	5	50	30	50	200	10	1	0.5		0.9	10	6	300		10				27
EN956	TO-106	75	40	7	50	60	20		0.01	10	1.5		1.3	150	25	70		30		8	5	20
							75		10	10												
							100	300	150	10												
							40		500	10												
EN1711	TO-106	75	40	7	50	60	20		0.01	10	1.5		1.3	150	25	70		30		8	5	20
							35		0.1	10												
							75		10	10												
							100	300	150	10												
							40		500	10												
EN2219	TO-105	60	30	5	50	50	35		0.1	10	0.4		1.3	150	8	250		20				20
							75		10	10	1.6		2.6	500								
							100	300	150	10												
							30		500	10												
EN2222	TO-106	60	30	5	50	50	35		0.1	10	0.4		1.3	150	8	250		20				20
							75		10	10	1.6		2.6	50								
							100	300	150	10												
							30		500	10												
MPSA10	TO-92(72)		40	4	100	30	40	400	5	10					4	50		5				27
MPSA20	TO-92(72)		40	4	100	30	40	400	5	10	0.25			10	4	125		5				27
MPS2711	TO-92(72)	18	18	5	500	18	30	90	2	4.5					4							23
MPS2712	TO-92(72)	18	18	5	500	18	75	225	2	4.5					4							23
MPS2716	TO-92(72)				500	18	75	225	2	4.5					3.5							23
MPS2923	TO-92(72)	25	25	5	500	25	90	180	2	10					12							23
MPS2924	TO-92(72)	25	25	5	500	25	150	300	2	10					12							23
MPS2925	TO-92(72)	25	25	5	500	25	235	470	2	10					12							23
MPS2926	TO-92(72)	18	18	5	500	18	35	470	2	10					3.5							23
MPS3392	TO-92(72)	25	25	5	100	18	150	300	2	4.5					3.5							04
MPS3393	TO-92(72)	25	25	5	100	18	90	180	2	4.5					3.5							04
MPS3394	TO-92(72)	25	25	5	100	18	55	110	2	4.5					3.5							04
MPS3395	TO-92(72)	25	25	5	100	18	150	500	2	4.5					3.5							04
MPS3396	TO-92(72)	25	25	5	100	18	90	500	2	4.5					3.5							04
MPS3397	TO-92(72)	25	25	5	100	18	55	500	2	4.5					3.5							04
MPS3398	TO-92(72)	25	25	5	100	18	55	800	2	4.5					3.5							04
MPS3642	TO-92(72)	60	45	5	50 (I_{CES})	50	40	120	150	10	0.22			150	8	250		50				19
							15		500	10												
MPS3704	TO-92(72)	50	30	5	100	20	100	300	50	2	0.6			100	12	100		50				13
MPS3705	TO-92(72)	50	30	5	100	20	50	150	50	2	0.8			100	12	100		50				13
MPS3706	TO-92(72)	40	20	5	100	20	30	600	50	2	1			100	12	100		50				13
MPS3721	TO-92(72)	25	25	5	500	18	60	660	2	10					3.5							23
MPS3826	TO-92(72)	60	45	4	100	30	40	160	10	10					3.5	200	800	10				23

MPS3827	TO-92(72)	60	45	4	100	30	100	400	10	10					3.5	200	800	10				23
MPS5172	TO-92(72)	25	25	5	100	25	100	500	10	10	0.25			10	10							27
MPS6512	TO-92(72)	40	30	4	50	30	50	100	2	10	0.5			50	3.5							27
							30		100	10												
MPS6513	TO-92(72)	40	30	4	50	30	90	180	2	10	0.5			50	3.5							27
							60		100	10												
MPS6514	TO-92(72)	40	25	4	50	30	150	300	2	10	0.5			50	3.5							27
							90		100	10												
MPS6515	TO-92(72)	40	25	4	50	30	250	500	2	10	0.5			50	3.5							27
							150		100	10												
MPS6520	TO-92(72)	40	25	4	50	30	100		0.1	10	0.5			50	3.5				3		1	27
							200	300	2	10												
MPS6521	TO-92(72)	40	25	4	50	30	150		0.1	10	0.5			50	3.5				3		1	27
							300	600	2	10												
MPS6530	TO-92(72)	60	40	5	50	40	30		10	1	0.5		1	100	5							13
							40	120	100	1												
							25		500	10												
MPS6531	TO-92(72)	60	40	5	50	40	60		10	1	0.3		1	100	5							13
							90	270	100	1												
							50		500	10												
MPS6532	TO-92(72)	50	30	5	100	30	30		100	1	0.5		1.2	100	5							13
MPS6564	TO-92(72)		45	5	500	40	25		10	5	0.5			10	4							27
MPS6565	TO-92(72)	60	45	4	100	30	40	160	10	10	0.4			10	3.5	200		10				27
MPS6566	TO-92(72)	60	45	4	100	30	100	400	10	10	0.4			10	3.5	200		10				27
NS3903**	TO-18	60	40	6	50	30	20		0.1	1	0.2	0.65	0.85	10	4	250		10	225†		4	23
					(I_{CEX})		35		1	1	0.3		0.95	50						6	2	
							50	150	10	1												
							30		50	1												
							15		100	1												
NS3904**	TO-18	60	40	6	50	30	40		0.1	1	0.2	0.65	0.85	10	4	300		10	250†		4	23
					(I_{CEX})		70		1	1	0.3		0.95	50						5	2	
							100	300	10	1												
							60		50	1												
							30		100	1												
PN2221	TO-92(72)	60	30	5	10	50	20		0.1	10	0.4		1.3	150	8	250		20				19
							40	120	150	10	1.6		2.6	500								
							20		500	10												
PN2221A	TO-92(72)	75	40	6	10	60	20		0.1	10	0.3	0.6	1.2	150	8	250		20	285†			19
							40	120	150	10	1		2	500								
							25		500	10												
PN2222	TO-92(72)	60	30	5	10	50	35		0.1	10	0.4		1.3	150	8	250		20				19
							100	300	150	10	1.6		2.6	500								
							30		500	10												
PN2222A	TO-92(72)	75	40	6	10	60	35		0.1	10	0.3	0.6	1.2	150	8	300		20	285†			19
							100	300	150	10	1		2	500								
							40		500	10												
SE2001	TO-106	35	20	4	500	15	40	160	10	1	0.7		0.9	10	6	200		10				27
SE6001	TO-105	40	30	5	500	20	50	200	10	10	1		0.9*	100	25	40		30				20
SE6002	TO-105	40	30	5	500	20	150	600	10	10	1		0.9*	100	25	40		30				20

Test Conditions

1. I_C = 150 mA, V_{CC} = 30V, $I_{B1} = I_{B2}$ = 15 mA
2. I_C = 100μA, V_{CE} = 5.0V, R_G = 1.0 kΩ, BW = 15.7 kHz
3. I_C = 10μA, V_{CE} = 5.0V, R_G = 10 kΩ, W.B.
4. V_{CC} = 3.0V, I_C = 10 mA, $I_{B1} = I_{B2}$ = 1.0 mA
5. I_C = 300μA, V_{CE} = 10V, R_G = 510Ω, f = 1.0 kHz
6. V_{CE} = 4.5V, I_C = 100μA, R_G = 500Ω, B_W = 15.7 kHz
7. V_{CC} = 6.0V, I_C = 150 mA, $I_{B1} = I_{B2}$ = 15 mA

*$V_{BE(ON)}$

**Metal Can equivalents of 2N3903 and 2N3904

($t = t_s + t_f$)

NPN Transistors

POWER

Type No.	Case Style	$V_{CEX(SUS)}$ (V) Min	$V_{CEO(SUS)}$ (V) Min	V_{EBO} (V) Min	I_{CEX} (mA) Max	@ V_{CE} (V)	h_{FE} Min	Max	@ I_C (A)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max	& $V_{BE(sat)}$ (V) Min	Max	@ I_C (A)	f_T (MHz) Min	Max	@ I_C (A)	Process No.
2N3054	TO-66	90	55	7	1	90	25		0.5	4	1		1.7	0.5	0.8		0.2	1A
							5		3	4	6			3				
2N3055	TO-3	90	60	7	5	100	20	70	4	4	1.1		1.8	4	0.8		1	1B
							5		10	4	8			10				
2N3442	TO-3	160	140	7	5	140	20	70	3	4	1		1.7	3				1C
											5		5.7	10				
2N3771	TO-3	50	40	5	2	50	15	60	15	4	2		2.7	15	0.2		1	1D
							5		30	4	4			30				
2N3772	TO-3	80	60	7	2	100	15	60	10	4	1.4		2.2	10	0.2		1	1D
							5		20	4	4			20				
2N3773	TO-3	160	140	7	5	140	15	60	8	4	1.4		2.2	8	0.2		1	1E
							5		16	4	4			16				
2N4347	TO-3	140	120	7	2	125	15	60	2	4	1		2	2				1C
									5	4	2		3	5				
2N4348	TO-3	140	120	7	2	120	15	60	5	4	1		2	5	0.2		1	1E
							10		10	4	2		3	10				
2N6253	TO-3	55	45	5	2	55	20	70	3	4	1		1.7	3	0.8		1	1B
							3		15	4	4			15				

NPN Transistors

MEDIUM POWER AMPS

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max	& $V_{BE(sat)}$ (V) Min	Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
40314	TO-39		40	2.5	250	15	70	350	50	4	1.4			150								12
2N2017	TO-39	60	60	8	10 μA	30	35		10	10	2			200								12
							50	200	200	10												
							20		1A	15												
2N2102	TO-39	120	65	7	2	60	10		0.01	10	0.5		1.1	150	10	60		50				12
							20		0.1	10												
							35		10	10												
							40	120	150	10												
							25		500	10												
							10		1A	10												
2N2192	TO-39	60	40	5	10	30	75		10	10	0.35		1.3	150	20	50		50				12
							100	300	150	10												
							15		1A	10												
2N2192A	TO-39	60	40	5	10	30	75		10	10	0.25		1.3	150	20	50		50				12
							100	300	150	10												
							15		1A	10												
2N2193	TO-39	80	50	8	10	60	15		0.1	10	0.35		1.3	150	20	50		50				12
							40	120	150	10												
							15		1A	10												
2N2193A	TO-39	80	50	8	10	60	15		0.1	10	0.25		1.3	150	20	50		50				12
							40	120	150	10												
							15		1A	10												

2N2195	TO-39	45	25	5	100	30	20		150	10	0.35	1.3	150	20	50		50				12
2N2195A	TO-39	45	25	5	100	30	20		150	10	0.25	1.3	150	20	50		50				12
2N2243	TO-39	120	80	7	10	60	15		0.1	10	0.35	1.3	150	15	50		50				12
							40	120	150	10											
							15		500	10											
2N2243A	TO-39	120	80	7	10	60	15		0.1	10	0.25	1.3	150	15	50		50				12
							40	120	150	10											
							15		500	10											
2N2270	TO-39	60	45	7	50	60	30		1	10	0.9	1.2	150	15	100		50				12
							50	200	150	10											
2N2657	TO-39	80	60	8	100	60	40	120	1A	2	0.5	1.5	1A	150	20		200	1500		1	34
							15		5A	6	3	2.5	5A								
2N2658	TO-39	100	80	8	100	60	40	120	1A	2	0.5	1.5	1A	150	20		200	1500		1	34
							15		5A	6	3	2.5	5A								
2N2890	TO-39	100	80	5			20		100	2	0.5	1.2	1A	70	30		200	1500		1	34
							30	90	1A	2	0.75	1.3	2A								
							25		2A	5											
2N2891	TO-39	100	80	5			35		100	2	0.5	1.2	1A	70	30		200	1500		1	34
							50	150	1A	2	0.75	1.3	2A								
							40		2A	5											
2N3019	TO-39	140	80	7	10	90	50		0.1	10	0.2	1.1	150	12	100		50				12
							100	300	150	10	0.5		500								
							15		1A	10											
							90		10	10											
JAN2N3019	TO-39	140	80	7	10	90	15		1A	10	0.2	1.1	150	12	100	400	50				12
							50	200	0.1	10	0.5		500								
							90		10	10											
							100	300	150	10											
							50	200	500	10											
JANTX2N3019	TO-39	140	80	7	10	90	50	200	0.1	10	0.20	1.1	150	12	100	400	50				12
							90		10	10	0.50		500								
							100	300	150	10											
							50	200	500	10											
							15		1A	10											
JANTXV2N3019	TO-39	140	80	7	10	90	50	200	0.1	10	0.2	1.1	150	12	100	400	50				12
							90		10	10	0.5		500								
							100	300	150	10											
							50	200	500	10											
							15		1A	10											
2N3020	TO-39	140	80	7	10	90	30	100	0.1	10	0.2	1.1	150	12	100		50				12
							40	120	150	10	0.5		500								
							15		1A	10											
							40	120	10	10											
2N3053	TO-39	60	40	5			25		150	2.5	1.4	1.7	150	15	100		50				12
							50	250	150	10											
2N3107	TO-39	100	60	7			100	300	150	1	1	2	1A	20	350		50				12
							35		0.1	10	0.25	1.1	150								
							40		500	10											
2N3108	TO-39	100	60	7	10	60	20		0.1	10	0.25	1.1	150	20	60		50				12
							40	120	150	10	1	2	1A								
							25		500	10											
2N3109	TO-39	80	40	7	10	60	35		0.1	10	0.25	1.1	150	25	70		50				12
							100	300	150	1	1	2	1A								
							40		500	10											
2N3110	TO-39	80	40	7	10	60	20		0.1	10	0.25	1.1	150	25	60		50				12
							40		150	1	1	2	1A								
							25		500	10											

Test Conditions:

1. V_{CC} = 20V, I_C = 1.0A, $I_{B1} = I_{B2}$ = 100 mA
2. V_{CE} = 10V, I_C = 100μA, R_G = 1.0 kΩ, f = 1.0 kHz
3. I_C = 2.0A, V_{CC} = 40V, $I_{B1} = I_{B2}$ = 200 mA

NPN Transistors

MEDIUM POWER AMPS (Cont.)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) @ V_{CB} (V) Max		h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max	& $V_{BE(sat)}$ (V) Min	$V_{BE(sat)}$ (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
2N3567	TO-105	80	40	5	50	40	40		30	1	0.25			150	20	60	200	50				14
							40	120	150	1												
2N3568	TO-105	80	60	5	50	40	40		30	1	0.25			150	20	60	200	50				14
							40	120	150	1												
2N3569	TO-105	80	40	5	50	40	100		30	1	0.25			150	20	60	200	50				14
							100	300	150	1												
2N3665	TO-39	120	80	10	50	60	30		10	10	0.5		1.2	150	12	60		50				12
							40	120	150	10	1.2		1.8	500								
							25		500	10												
2N3666	TO-39	120	80	10	50	60	70		10	10	0.5		1.2	150	12	60		50				12
							100	300	150	10	1.2		1.8	500								
							50		500	10												
2N3700	TO-18	140	80	7	10	90	50		0.1	10	0.2		1.1	150	12	100	200	50		4	2	12
							90		10	10	0.5			500								
							100	300	150	10												
							50		500	10												
							15		1A	10												
2N3742	TO-39	300	300	7	200	200	10		3	10	1		1	10	6	30		10				48
							15		10	10	5		1.2	30								
							20	200	30	10												
							20		50	20												
2N3945	TO-39	70	50	8			25		10	10	0.5		1.2	150	12	60		50				12
							40	250	150	10	1.8		1.8	500								
							20		500	10												
2N4237	TO-39		40		100 μA	50	30	150	250	1	0.3			500	100	1		100				14
							30		500	4	0.6		1.5	1A								
							15		1A	1			1	250								
2N4238	TO-39		60		100 μA	80	30	150	250	1	0.3			500	100	1		100				14
							30		500	4	0.6		1.5	1A								
							15		1A	1			1	250								
2N4924	TO-39	100	100	5	100	50	25		1	10	0.25			10	10	100	500	20				12
							35		10	10	0.4		0.95	50								
							40	200	150	10												
2N4926	TO-39	200	200	7	100	100	10		3	10					6 C_{cb}	30	300	10				48
							15		10	10												
							20	200	30	10												
							20		50	20												
2N4927	TO-39	250	250	7	100	150	10		3	10					6 C_{cb}	30	300	10				48
							15		10	10												
							20	200	30	10												
							20		50	20												
2N4943	TO-39	120	80	7	10	60	60		10	10	0.25		0.95	150	12	150	1000	50				12
							100	300	150	10												
							10		500	10												

2N5148	TO-39		80				5		3A	5	5		3	3A	70	50		200				34
							15		2A	5	0.85		1.5	2A	C_{cb}							
							30	90	1A	5	0.46		1.2	1A								
							20		50	5			1.5	2A								
2N5150	TO-39		80				15		3A	5	5		3	3A	70	60		200				34
							30		2A	5	0.85		1.5	2A	C_{cb}							
							70	200	1A	5	0.46		1.2	1A								
							50		50	5			1.5	2A								
2N5336	TO-39		80		10 μA	80	30		500	2	0.7		1.2	2A		30		500	2200		3	34
							30	120	2A	2	1.2		1.8	5A								
							20		5A	2												
2N5337	TO-39		80		10 μA	80	60		500	2	0.7		1.2	2A		30		500	2200		3	34
							60	240	2A	2	1.2		1.8	5A								
							40		5A	2												
2N5338	TO-39		100		10 μA	100	30		500	2	0.7		1.2	2A		30		500	2200		3	34
							30	120	2A	2	1.2		1.8	5A								
							20		5A	2												
2N5339	TO-39		100		10 μA	100	60		500	2	0.7		1.2	2A		30		500	2200		3	34
							60	240	2A	2	1.2		1.8	5A								
							40		5A	2												
CS9013	TO-105		25	3			64	202	50	1	1			250								09
MPSA05	TO-92(72)		60	4	100	60	50		10	1	0.25			100		50		100				12
							50		100	1												
MPSA06	TO-92(72)		80	4	100	80	50		10	1	0.25			100		50		100				12
							50		100	1												
MPS6560	TO-92(72)		25	5	100	20	35		10	1	0.50			500	30	60		10				14
							50		100	1												
							50	200	500	1												
MPS6561	TO-92(72)		20	5	100	20	35		10	1	0.50			350	30	60		10				14
							50		100	1												
							50	200	350	1												

Test Conditions:

1. V_{CC} = 20V, I_C = 1.0A, $I_{B1} = I_{B2}$ = 100 mA
2. V_{CE} = 10V, I_C = 100μA, R_G = 1.0 kΩ, f = 1.0 kHz
3. I_C = 2.0A, V_{CC} = 40V, $I_{B1} = I_{B2}$ = 200 mA

NPN Transistors

DARLINGTON AMPS

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) @ V_{CB} (V) Max		h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max	& $V_{BE(sat)}$ (V) Min	$V_{BE(sat)}$ (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
2N5305	TO-92(74)				100	25	2,000	20,000	2	5	1.4			200	10	60		2				05
2N5306	TO-92(74)				100	25	7,000	70,000	2	5	1.4			200	10	60		2				05
2N5307	TO-92(74)				100	40	2,000	20,000	2	5	1.4			200	10	60		2				05
2N5308	TO-92(74)				100	40	7,000	70,000	2	5	1.4			200	10	60		2				05
MPSA12	TO-92(72)	20 (V_{CES})			100 (I_{CES})	15	20,000				1			10								05
MPSA13	TO-92(72)	30 (V_{CES})			100	30	5,000		10	5	1.5			100		125		10				05
							10,000		100	5												
MPSA14	TO-92(72)	30 (V_{CES})			100	30	10,000		10	5	1.5			100		125		10				05
							20,000		100	5												

NPN Transistors

DUAL DIFFERENTIAL AMPS

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) @ V_{CB} (V) Max		h_{FE} Min	h_{FE} Max	@ I_C (mA)	h_{FE1} / h_{FE2} (%) Max	$V_{BE1} - V_{BE2}$ (mV) Max	$\Delta V_{BE1} - V_{BE2}$ / ΔT ($\mu V/^\circ C$) Max	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	NF (dB) Max	Test Condition	Process No.
2N2453	TO-78	60	30	7	5	50	80		0.01		3	10	8	60		7	1	07
							150	600	1	10	5							
2N2453A	TO-78	80	50	7	5	60	80		0.01		3	5	4	60		4	1	07
							150	600	1	10	5							
2N2639	TO-78	45	45	5	10	45	50	300	0.01	10	5	10	8	80		4	2	07
							55		0.1									
							65		1									
2N2640	TO-78	45	45	5	10	45	50	300	0.01	20	10	20	8	80		4	2	07
							55		0.1									
							65		1									
2N2641	TO-78	45	45	5	10	45	50	300	0.01				8	80		4	2	07
							55		0.1									
							65		1									
2N2642	TO-78	45	45	5	10	45	100	300	0.01	10	5	10	8	80		4	2	07
							110		0.1									
							130		1									
2N2643	TO-78	45	45	5	10	45	100	300	0.01	20	10	20	8	80		4	2	07
							110		0.1									
							130		1									
2N2644	TO-78	45	45	5	10	45	100	300	0.01				8	80		4	2	07
							110		0.1									
							130		1									
2N2722	TO-78	45	45	5	1	30	50	250	0.001	10			6	100		4	2	07
							100		0.01		5	10						
							125		0.1									
2N2903	TO-78	60	30	7	10	50	60		0.01		10	20	8	60		7	1	07
							125	625	1	20								
2N2903A	TO-78	60	30	7	10	50	60		0.01		5	10	8	60		7	1	07
							125	625	1	10								
2N2913	TO-78	45	45	6	10	45	60	240	0.01				6	60		4	2	07
							100		0.1							4	3	
							150		1									
2N2914	TO-78	45	45	6	10	45	150	600	0.01				6	60		3	2	07
							225		0.1							3	3	
							300		1									
2N2915	TO-78	45	45	6	10	45	60	240	0.01		5		6	60		4	2	07
							100		0.1	10	3	10				4	3	
							150		1		5							
2N2915A	TO-78	45	45	6	10	45	60	240	0.01		2		6	60	160	4	2	07
							100		0.1	10	1.5	5				4	3	
							150		1	15*	2							
2N2916	TO-78	45	45	6	10	45	150	600	0.01		5		6	60		3	2	07
							225		0.1	10	3	10				3	3	
							300		1		5							
2N2916A	TO-78	45	45	6	10	45	150	600	0.01		2		6	60	160	3	2	07
							225		0.1	10	1.5	5				3	3	
							300		1	15*	2							
2N2917	TO-78	45	45	6	10	45	60	240	0.01		10	20	6	60		4	2	07
							100		0.1	20	5					4	3	
							150		1		10							

2N2918	TO-78	45	45	6	10	45	150 225 300	600	0.01 0.1 1	20	10 5 10	20	6	60		3 3	3 2	07
2N2919	TO-78	60	60	6	2	45	60 100 150	240	0.01 0.1 1	10	5 3	10	6	60		4 4	3 2	07
2N2919A	TO-78	60	60	6	2	45	60 100 150	240	0.01 0.1 1	10 15†	2 1.5 2	5	6	60	160	4 4	3 2	07
2N2920	TO-78	60	60	6	2	45	150 225 300	600	0.01 0.1 1	10	5 3 5	10	6	60		3 3	3 2	07
JAN2N2920	TO-78	70	60	6	2	45	150 225 300	600	0.01 0.1 1	10	5 3 5	10	6	60	400	3 3 5	3 2 4	07
JANTX2N2920	TO-78	70	60	6	2	45	175 235 300	600	0.01 0.1 1	10	5 3 5	10	5	60	400	3 3 5	3 2 4	07
JANTXV2N2920	TO-78	70	60	6	2	45	175 235 300	600	0.01 0.1 1	10	5 3 5	10	5	60	400	3 3 5	3 2 4	07
2N2920A	TO-78	60	60	6	2	45	150 225 300	600	0.01 0.1 1	10 15†	2 1.5 2	5	6	60	160	3 3	5 2	07
2N2972	TO-71	45	45	6	10	45	60 100 150	240	0.01 0.1 1				6	60		4 4	3 2	07
2N2973	TO-71	45	45	6	10	45	150 225 300	600	0.01 0.1 1				6	60		3 3	3 2	07
2N2974	TO-71	45	45	6	10	45	60 100 150	240	0.01 0.1 1	10	5 3 5	10	6	60		4 4	3 2	07
2N2975	TO-71	45	45	6	10	45	150 225 300	600	0.01 0.1 1	10	5 3 5	10	6	60		3 3	3 2	07
2N2976	TO-71	45	45	6	10	45	60 100 150	240	0.01 0.1 1	20	10 5 10	20	6	60		4 4	3 2	07
2N2977	TO-71	45	45	6	10	45	150 225 300	600	0.01 0.1 1	20	10 5 10	20	6	60		3 3	3 2	07
2N2978	TO-71	60	60	6	2	45	60 100 150	240	0.01 0.1 1	10	5 3 5	10	6	60		4 4	3 2	07
2N2979	TO-71	60	60	6	2	45	150 225 300	600	0.01 0.1 1	10	5 3 5	10	6	60		3 3	3 2	07
2N3587	TO-78	60	45	5	10	40	50 80	500	0.1 1	20†	20	20	8	80	200	10	3	07
2N3680	TO-78	60	50	6	10	45	150 225 300	600	0.01 0.1 1	10	3	5	6	60	180	3	2	07
2N3907	TO-78	60	45	6	10	45	60 70 120	300 500	0.01 0.1 1	10	2 1 2.5	5	6	60	240	4	3	07

Test Conditions: 1. I_C = 10μA, V_{CE} = 5.0V, R_G = 10 kΩ, f = 1.0 kHz

2. I_C = 10μA, V_{CE} = 5.0V, R_G = 10 kΩ, BW = 15.7 kHz

3. I_C = 10μA, V_{CE} = 5.0V, R_G = 10 kΩ, f = 1.0 kHz, BW = 200 Hz

4. I_C = 10μA, V_{CE} = 5.0V, R_G = 10 kΩ, f = 100 Hz

5. I_C = 100μA, V_{CE} = 5.0V, R_G = 10 kΩ, BW = 15.7 kHz

* This parameter measured at frequency = 1.0 kHz.

†T_A = –55°C to +125°C.

NPN Transistors

DUAL DIFFERENTIAL AMPS (Cont.)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	h_{FE1}/h_{FE2} (%) Max	$V_{BE_1} - V_{BE_2}$ (mV) Max	$\Delta V_{BE1} - V_{BE2}$ ΔT (μV/°C) Max	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	NF (dB) Max	Test Condition	Process No.
2N3908	TO-78	60	60	6	2	45	100	500	0.01		2		6	60	240	3	3	07
							125	800	0.1	10	1	5						
							200		1		2.5							
ND5700	TO-78	45	45	6	0.2	50	200	1500	0.01	5	0.5	2	3			3	5	570
							200	2000	1									
							200	2000	5									
ND5701	TO-78	45	45	6	0.2	50	200	1500	0.01	10	1	5	3			3	5	570
							200	2000	1									
							200	2000	5									
ND5702	TO-78	45	45	6	0.2	50	200	1500	0.01	10	2	10	3			3	5	570
							200	2000	1									
							200	2000	5									

Test Conditions:
1. I_C = 10μA, V_{CE} = 5.0V, R_G = 10 kΩ, f = 1.0 kHz
2. I_C = 10μA, V_{CE} = 5.0V, R_G = 10 kΩ, BW = 15.7 kHz
3. I_C = 10μA, V_{CE} = 5.0V, R_G = 10 kΩ, f = 1.0 kHz, BW = 200 Hz
4. I_C = 10μA, V_{CE} = 5.0V, R_G = 10 kΩ, f = 100 Hz
5. I_C = 100μA, V_{CE} = 5.0V, R_G = 10 kΩ, BW = 15.7 kHz

* This parameter measured at frequency = 1.0 kHz.

†T_A = −55°C to +125°C.

NPN Transistors

HIGH VOLTAGE

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max	& $V_{BE(sat)}$ (V) Min	$V_{BE(sat)}$ (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
2N3498	TO-39	100	100	6	50	50	20		0.1	10	0.2		0.8	10	10	150		20				08
							25		1	10	0.25		0.9	50								
							35		10	10	0.6		1.4	300								
							40	120	150	10												
							15		500	10												
2N3499	TO-39	100	100	6	50	50	35		0.1	10	0.2		0.8	10	10	150		20				08
							50		1	10	0.25		0.9	50								
							75		10	10	0.6		1.4	300								
							100	300	150	10												
							20		500	10												
2N3500	TO-39	150	150	6	50	75	20		0.1	10	0.2		0.8	10	6	150		20				08
							25		1	10	0.25		0.9	50								
							35		10	10	0.4		1.2	150								
							40	120	150	10												
							15		300	10												
2N3501	TO-39	150	150	6	50	75	35		0.1	10	0.2		0.8	10	8	150		20				08
							50		1	10	0.25		0.9	50								
							75		10	10	0.4		1.2	150								
							100	200	150	10												
							20		300	10												
2N5550	TO-92	160	140	6	100	100	60		1	5	0.15		1	10	6	100	300	10		10	1	16
							60	250	10	5	0.25		1.2	50								
							20		50	5												

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max	& $V_{BE(sat)}$ (V) Min	$V_{BE(sat)}$ (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
2N5551	TO-92	180	160	6	50	120	80		1	5	0.15		1	10	6	100	300	10		8	1	16
							80	250	10	5	0.2		1	50								
							30		50	5												
2N5832	TO-92(74)	160	140	5	50	120	125		1	5	0.2		1.0	10	4	100	500	10				15
							175		10	5	0.15		0.8	1								
							150		50	5	0.25		1.0	50								
40321	TO-39		300 V_{CER}	5	100	150	25	200	20	10												48
MPSA42	TO-92	300	300	8	100	200	25		1	10	0.5		0.9	20	3	50		10				48
							40		1	10												
							40		30	10												
MPSA43	TO-92	200	200	6	100	160	25		1	10	0.4		0.9	20	4	50		10				48
							40		10	10												
							50	200	30	10												
MPSL01	TO-92	140	120	5	1 μA	75	50	300	10	5	0.2		1.2	10	8	60		10				16
											0.3		1.4	50								
SE7055	TO-39	220	220	7	100	150	20		1	20	1.0		0.85	20	3.5	50		15				48
							40		10	20												
							40		30	20												
SE7056	TO-39	300	300	7	100	200	20		1	20	1		0.85	20	3	50		15				48
							40		10	20												
							40		30	20												
SV7056	TO-202	300	300	7	100	200	20		1	20	1		0.85	20	3	50		15				48
							40		10	20												
							40		30	10												

Test Conditions 1. V_{CE} = 5.0V, I_C = 250 mA
R_S = 1.0 kΩ, W.B.

DURAWATT

NPN Transistors

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max	& $V_{BE(sat)}$ (V) Min	$V_{BE(sat)}$ (V) Max	@ I_C* (mA)	C_{ob} @ V_{CB} = 10V (pF) Max	f_T (MHz) Min	@ I_C (mA)	Process No.
NSD102	TO-202(35)	60	45	5	50	30	40		10	5	0.2		1.0	100	8	100	50	14
							50	150	100	5	0.4		1.2	500				
							40		1A	5								
							25		1A	5								
NSD103	TO-202(35)	60	45	5	50	30	50		10	5	0.2		1.0	100	10	100	50	14
							120	350	100	5	0.4		1.2	500				
							50		500	5								
							30		1A	5								
NSD104	TO-202(35)	140	80	7	50	90	20		10	5	0.2		0.9	100	10	80	50	12
							50	150	100	5	0.5		1.2	500				
							10		1A	5								
NSD105	TO-202(35)	140	80	7	50	90	20		10	5	0.2		0.9	100	10	80	50	12
							120	360	100	5	0.5		1.2	500				
							10		1A	5								
NSD106	TO-202(35)	140	100	7	50	90	20		10	5	0.2		0.9	100	10	80	50	12
							50	150	100	5	0.5		1.2	500				
							25		500	5								

DURAWATT (Cont.)

NPN Transistors

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max	& $V_{BE(sat)}$ (V) Min	$V_{BE(sat)}$ (V) Max	@ I_C* (mA)	C_{ob} @ V_{CB} = 10V (pF) Max	f_T (MHz) Min	@ I_C (mA)	Process No.
NSD123	TO-202(35)	120	120	6	50	50	20		0.1	10	0.4		1.2	150	10	150	20	08
							25		1	10								
							35		10	10								
							40	300	150	10								
							15		300	10								
NSD127	TO-202(35)	120	120	5	50	60	50		1	5	0.15		1.0	10	6	100	10	15
							50	500	10	5	0.25		1.2	50				
							20		50	5								
NSD128	TO-202(35)	180	180	5	50	120	50		1	5	0.15		1.0	10	6	100	10	15
							50	500	10	5	0.25		1.2	50				
							20		50	5								
NSD129	TO-202(35)	225	225	5	50	120	50		1	5	0.15		1.0	10	6	100	10	15
							50	500	10	5	0.25		1.2	50				
							20		50	5								
NSD130	TO-202(35)	250	250	7	100	150	15		1	10	1		0.85	20	4*	50	15	48
							15		10	10								
							30	90	30	10								
NSD132	TO-202(35)	250	250	7	100	150	15		1	10	1		0.85	20	4*	50	15	48
							30		10	10								
							60	180	30	10								
NSD133	TO-202(35)	300	300	7	100	150	15		1	10	1		0.85	20	4*	50	15	48
							15		10	10								
							30	90	30	10								
NSD134	TO-202(35)	300	300	7	100	150	15		1	10	1		0.85	20	4*	50	15	48
							30		10	10								
							60	180	30	10								
NSD135	TO-202(35)	375	375	7	100	150	15		1	10	1		0.85	20	4*	50	15	48
							30		10	10								
							30		3	10								
SV7056	TO-202(35)	300	300	7	100	200	20		1	20	1		0.85	20	3*	50	15	48
							40		10	20								
							40		30	20								
NSD151	TO-202(35)	30 BV_{CES}		12	100 I_{CES}	15	20,000		10	5	1.5		2.0**	100	8	100	10	05
							5,000-250,000		100	5								
NSD152	TO-202(35)	40 BV_{CES}		12	100 I_{CES}	15	20,000		10	5	1.5		2.0**	100	8	100	10	05
							5,000-250,000		100	5								
NSD457† (BF457)	TO-202(36)	160	160	5	50	100	25		30	10	1			30				15
NSD458† (BF458)	TO-202(36)	250	250	5	50	200	25		30	10	1			30				15
NSD459† (BF459)	TO-202(36)	300	300	5	50	250	25		30	10	1			30				15

†Electrically but not mechanically identical to pro electron type numbers. *C_{cb} **$V_{BE(ON)}$ •I_C/I_B = 10

PNP Transistors

SATURATED SWITCHES

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) @ V_{CB} (V) Max	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max	$V_{BE(sat)}$ (V) Min	$V_{BE(sat)}$ (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
2N869	TO-52	25		5	10 15	20		10	5			1	10		100		10	18			64
												1	10								
2N869A	TO-52	25	18	5	10 15 (I_{CES})	40	120	30	0.5	0.15	0.78	0.98	10	6	400		10	80		8	64
						40	120	10	5	0.2	0.85	1.2	30								
						30		10	0.3	0.5		1.7	100								
						25		100	1												
2N995	TO-52	20	15	4	50 15	35	140	20	1	0.2		0.95	20	10	100		10				64
2N995A	TO-52	20	15	4	5 15	25		1	1	0.2		0.95	20	6	100		10	90		2	64
						35	140	20	1	0.5		1.7	100		400		30				
						25		50	1												
						25		100	1												
2N2894	TO-52	12	12	4	80 6 (I_{CES})	40	150	30	0.5	0.15	0.78	0.98	10	6	400		30	90		2	64
						30		10	0.3	0.2	0.85	1.2	30								
						25		100	1	0.5		1.7	100								
2N2894A	TO-52	12	12	4.5	50 10 (I_{CES})	20		10	0.5	0.13	0.78	0.92	10	4.5	800		30	25		3	64
						30		10	0.3	0.19	0.85	1.15	30					35		2	
						40	120	30	0.5	0.45	1	1.5	100								
						30		100	1												
2N3012	TO-52	12	12	4	80 6 (I_{CES})	30	120	30	0.5	0.15	0.78	0.98	10	6	400		30	75		2	64
						25		10	0.3	0.2	0.85	1.2	30								
						20		100	1	0.5		1.7	100								
2N3209	TO-52	20	20	4	80 10 (I_{CES})	30	120	30	0.5	0.15	0.78	0.98	10	5	400		30	90		2	64
						25		10	0.3	0.2	0.85	1.2	30								
						15		100	1	0.6		1.7	100								
2N3244	TO-5 (Lo-Profile)	40	40	5	50 30	60		150	1	0.3		1.1	150	25	175		50	195		9	70
						50	150	500	1	0.5	0.75	1.5	500								
						25		750	5	1		2	750								
2N3245	TO-5 (Lo-Profile)	50	50	5	50 50	35		150	1	0.35		1.1	150	25	150		50	165		9	70
						30	90	500	1	0.6	0.75	1.5	500								
						20		1A	5	1.2		2	1A								
2N3248	TO-52	15	12	5	50 10 (I_{CEX})	50	150	0.1	1	0.12	0.6	0.9	10	8	250		20	100		1	64
						50		1	1	0.25	0.7	1.1	50								
						50		10	1	0.40		1.3	100								
						35		50	1												
						25		100	1												
2N3249	TO-52	15	12	5	50 10 (I_{CEX})	100	300	0.1	1	0.125	0.6	0.9	10	8	250		20	100		1	64
						100		1	1	0.25	0.7	1.1	50								
						100		10	1	0.45		1.3	100								
						75		50	1												
						35		100	1												
2N3250	TO-18	50	40	5		40		0.1	1	0.25	0.6	0.9	10	6	250		10	225		7	69
						45		1	1	0.5		1.2	50						6	4	
						50	150	10	1												
						15		50	1												

Test Conditions:

1. I_C = 100 mA, $I_{B1} = I_{B2}$ = 10 mA
2. I_C = 30 mA, $I_{B1} = I_{B2}$ = 1.5 mA
3. I_C = 30 mA, $I_{B1} = I_{B2}$ = 3.0 mA
4. I_C = 100μA, V_{CE} = 5.0V, R_G = 1.0 kΩ, f = 100 Hz
5. I_C = 10 mA, $I_{B1} = I_{B2}$ = 0.5 mA
6. I_C = 50 mA, $I_{B1} = I_{B2}$ = 5.0 mA
7. I_C = 10 mA, $I_{B1} = I_{B2}$ = 1.0 mA
8. I_C = 30 mA, I_{B1} = 3.0 mA, I_{B2} = 1.5 mA
9. I_C = 500 mA, $I_{B1} = I_{B2}$ = 50 mA
10. I_C = 1·A, $I_{B1} = I_{B2}$ = 100 mA

*NSC replacements for 2N3762, 2N3763

PNP Transistors

SATURATED SWITCHES (Cont.)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) @ V_{CB} (V) Max	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max	$V_{BE(sat)}$ (V) Min	$V_{BE(sat)}$ (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
2N3250A	TO-18	60	60	5		40		0.1	1	0.25	0.6	0.9	10	6	250		10	225		7	69
						45		1	1	0.5		1.2	50						6	4	
						50	150	10	1												
						15		50	1												
JAN2N3250A	TO-18	60	60	5		40		0.1	1	0.25	0.6	0.9	10	6	250		10	225		7	69
						45		1	1	0.5		1.2	50						6	4	
						50	150	10	1												
						15		50	1												
JANTXV2N3250A	TO-18	60	60	5		40		0.1	1	0.25	0.6	0.9	10	6	250		10	225		7	69
						45		1	1	0.5		1.2	50						6	4	
						50	150	10	1												
						15		50	1												
2N3251	TO-18	50	40	5		80		0.1	1	0.25	0.6	0.9	10	6	300		10	250		7	69
						90		1	1	0.5		1.2	50						6	4	
						100	300	10	1												
						30		50	1												
2N3251A	TO-18	60	60	5		80		0.1	1	0.25	0.6	0.9	10	6	300		10	250		7	69
						90		1	1	0.5		1.2	50						6	4	
						100	300	10	1												
						30		50	1												
JAN2N3251A	TO-18	60	60	5		80		0.1	1	0.25	0.6	0.9	10	6	300		10	250		7	69
						90		1	1	0.5		1.2	50						6	4	
						100	300	10	1												
						30		50	1												
JANTX2N3251A	TO-18	60	60	5		80		0.1	1	0.25	0.6	0.9	10	6	300		10	250		7	69
						90		1	1	0.5		1.2	50						6	4	
						100	300	10	1												
						30		50	1												
JANTXV2N3251A	TO-18	60	60	5		80		0.1	1	0.25	0.6	0.9	10	6	300		10	250		7	69
						90		1	1	0.5		1.2	50						6	4	
						100	300	10	1												
						30		50	1												
2N3304	TO-52	6	6	4		30	120	10	0.3	0.15	0.7	0.8	1	3.5	500		10	60		5	65
						20		50	1	0.16	0.8	1	10								
						15		1	0.5	0.5		1.5	50								
2N3451	TO-52	6	6	4	10 I_{CES}	30	120	10	0.3	0.16	0.8	1	10	5.5	500		10	25		6	65
					3																
						20		50	1	0.25	0.75	0.95	10/5					60		5	
										0.5		1.5	50/5								
2N3467	TO-5 (Lo-Profile)	40	40	5	100	40		150	1	0.3		1	150	25	175		50	90		9	70
					30	40	120	500	1	0.5	0.8	1.2	500								
						40		1A	5	1		1.6	1A								
2N3468	TO-5 (Lo-Profile)	50	50	5	100	25		150	1	0.35		1	150	25	150		50	90		9	70
					30	25	75	500	1	0.6	0.8	1.2	500								
						20		1A	5	1.2		1.6	1A								
2N3545	TO-52	20	20	5	10	30		1	1	0.2	0.65	0.85	10	8	250		10	90		7	64
					10	40	120	10	1	0.3		1.1	50								
						35		50	1	0.5		1.3	100								
						30		100	1												
2N3546	TO-52	15	12	4.5	10	20		1	1	0.15	0.7	0.9	10	6	700		10	30		6	64
					10	30	120	10	1	0.25	0.8	1.3	50								
						25		50	1	0.5		1.6	100								

2N3576	TO-52	20	15	5	10 I_{CES}	15	40 10	120	10 100	0.5 1	0.15 0.5	0.75	0.95 1.1	10 100	4.5	400	10	50		7	64
2N3639	TO-106	6	6	4	10 I_{CES}	2	30 20	120	10 50	0.3 1	0.16 0.5 0.25	0.75 0.8	1.5 0.95 1	10/5 50 10/5 10/1	3.5	500 300	10 10	60		5	65
2N3640	TO-106	12	12	4	10 I_{CES}	6	30 20	120	10 50	0.3 1	0.2 0.6 0.3	0.8 0.75	1 1.5 0.95	10/1 50 10/5	3.5	500 300	10 10	35		6	65
2N4208	TO-52	12	12	4.5	10 I_{CES}	6	30 30 15	120	50 10 1	1 0.3 0.5	0.13 0.15 0.5	0.8	0.8 0.95 1.5	1 10 50	3	700	10	20		7	65
2N4209	TO-52	15	15	4.5	10 I_{CES}	8	40 50 35	120	50 10 1	1 0.3 0.5	0.15 0.18 0.6	0.8	0.8 0.95 1.5	1 10 50	3	850	10	20		7	65
2N4258	TO-106	12	12	4.5	10 I_{CES}	6	30 30 15	120	50 10 1	1 0.3 0.5	0.5 0.15		1.5 0.95	50 10	3	700	10	20		7	65
2N4258A	TO-106	12	12	4.5	10 I_{CES}	6	15 30 30	120	1 10 50	0.5 3 1	0.15 0.5	0.75	0.95 1.5	10 50	3	700	10	18		7	65
2N4313	TO-106	12	12	4.5	50 I_{CES}	10	18 30 30 25		1 10 30 100	0.5 1 0.5 1	0.13 0.19 0.45	0.95	0.92 1.15 1.5	10 30 100	4	700	30	25		3	64
2N4423	TO-106	12	12	4	80 I_{CES}	6	30 40 20	150	10 30 100	0.3 0.5 1	0.15 0.2 0.5			10 30 100	6	400	30	50		3	64
2N5022	TO-5 (Lo-Profile)	50	50	5	100 I_{CES}	30	15 25 25	100	100 500 1A	1 1 5	0.2 0.4 0.8	0.8	1 1.4 1.75	100 500 1A	25	170	50	90		9	70
2N5023	TO-5 (Lo–Profile)	30	30	5	100 I_{CES}	20	30 40 40	100	100 500 1A	1 1 5	0.17 0.35 0.7	0.8	1 1.4 1.75	100 500 1A	25	200	50	90		9	70
2N5055	TO-106	12	12	4.5	50 I_{CES}	10	12 20 30 20	100	1 10 30 100	0.5 1 0.5 1	0.13 0.19 0.45	0.8 0.95	0.92 1.15 1.5	10 30 100	4.5	550	20	25		3	64
2N5056	TO-52	15	15	4.5	50 I_{CES}	10	12 20 30 20	100	1 10 30 100	0.5 0.3 0.5 1	0.13 0.19 0.45	0.72 0.8 0.95	0.92 1.15 1.5	10 30 100	4.5	600	30	35		3	64
2N5057	TO-52	15	15	4.5	50 I_{CES}	10	20 30 40 30	100	1 10 30 100	0.5 0.3 0.5 1	0.13 0.19 0.45	0.72 0.8 0.95	0.92 1.15 1.5	10 30 100	4.5	800	30	35		3	64
2N5140	TO-106	5	5	4	50 I_{CES}	3	70 30 20	140	50 1 10	1 0.5 1	0.75 0.2		1.2	50 10	5	400	10	20		7	65
2N5141	TO-106	6	6	6	100 I_{CES}	4	15 25 30 15		1 10 30 100	2 2 2 5	0.2 0.25 0.6	0.8	1.1 1.25 2.0	10 30 100	7	300	20	150		3	64

Test Conditions:

1. I_C = 100 mA, $I_{B1} = I_{B2}$ = 10 mA
2. I_C = 30 mA, $I_{B1} = I_{B2}$ = 1.5 mA
3. I_C = 30 mA, $I_{B1} = I_{B2}$ = 3.0 mA
4. I_C = 100μA, V_{CE} = 5.0V, R_G = 1.0 kΩ, f = 100 Hz
5. I_C = 10 mA, $I_{B1} = I_{B2}$ = 0.5 mA
6. I_C = 50 mA, $I_{B1} = I_{B2}$ = 5.0 mA
7. I_C = 10 mA, $I_{B1} = I_{B2}$ = 1.0 mA
8. I_C = 30 mA, I_{B1} = 3.0 mA, I_{B2} = 1.5 mA
9. I_C = 500 mA, $I_{B1} = I_{B2}$ = 50 mA
10. I_C = 1·A, $I_{B1} = I_{B2}$ = 100 mA

*NSC replacements for 2N3762, 2N3763

PNP Transistors

SATURATED SWITCHES (Cont.)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) @ V_{CB} (V) Max	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(sat)}$ (V) & $V_{BE(sat)}$ (V) Max	$V_{BE(sat)}$ (V) Min	$V_{BE(sat)}$ (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
2N5771	TO-92(72)	15	15	4.5	10 @ 8	35		1	0.5	0.15		0.8	1	3	850		10	20		7	65
						50	120	10	0.3	0.18	0.8	0.95	10								
						40		50	1												
2N5910	TO-106	20	20	4.5	10 @ 20	30	120	10	0.3	0.5			50	3	700		10	20		7	65
MPS3639	TO-92(70)	6	6	4		30	120	10	0.3		0.75	0.95	10	3.5	500		10	25		6	65
						20		50	1	0.16	0.8	1	10		300		10	60		5	
										0.5		1.5	50								
MPS3640	TO-92(70)	12	12	4	10 @ 6	30	120	10	0.3	0.2	0.8	1	10	3.5	500		10	35		6	65
					I_{CES}	20		50	1	0.6		1.5	50					75		5	
NS3762*	TO-5 (Lo-Profile)	40	40	5	100 @ 20	35		10	1	0.15		0.8	10	18	180		50	115		10	70
					I_{CEX}	40		150	1	0.22		1	150								
						35		500	1	0.5		1.2	500								
						30	120	1A	1.5	0.9		1.4	1A								
						30		1.5A	5												
NS3763*	TO-5 (Lo-Profile)	60	60	5	100 @ 20	35		10	1	0.15		0.8	10	18	180		50	115		10	70
					I_{CEX}	40		150	1	0.22		1	150								
						35		500	1	0.5		1.2	500								
						20		1A	1.5	0.9		1.4	1A								
						20		1.5A	5												

Test Conditions:

1. I_C = 100 mA, $I_{B1} = I_{B2}$ = 10 mA
2. I_C = 30 mA, $I_{B1} = I_{B2}$ = 1.5 mA
3. I_C = 30 mA, $I_{B1} = I_{B2}$ = 3.0 mA
4. I_C = 100μA, V_{CE} = 5.0V, R_G = 1.0 kΩ, f = 100 Hz
5. I_C = 10 mA, $I_{B1} = I_{B2}$ = 0.5 mA
6. I_C = 50 mA, $I_{B1} = I_{B2}$ = 5.0 mA
7. I_C = 10 mA, $I_{B1} = I_{B2}$ = 1.0 mA
8. I_C = 30 mA, I_{B1} = 3.0 mA, I_{B2} = 1.5 mA
9. I_C = 500 mA, $I_{B1} = I_{B2}$ = 50 mA
10. I_C = 1·A, $I_{B1} = I_{B2}$ = 100 mA

*NSC replacements for 2N3762, 2N3763

PNP Transistors

LOW LEVEL AMPS

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) @ V_{CB} (V) Max	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(sat)}$ (V) & $V_{BE(sat)}$ (V) Max	$V_{BE(sat)}$ (V) Min	$V_{BE(sat)}$ (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
2N2604	TO-46	60	45	6	10 @ 45	40	120	0.01	5	0.5	0.7	0.9	10	6	30		0.5		4	1	62
						60		0.5	5												
							350	10	5												
JAN2N2604	TO-46	80	60	6	10 @ 50	40	120	0.01	5	0.5	0.7	0.9	10	6	30	300	0.5		3	1	62
						60		0.5	5												
							350	10	5												
JANTX2N2604	TO-46	80	60	6	10 @ 50	40	120	0.01	5	0.5	0.7	0.9	10	6	30	300	0.5		3	1	62
						60		0.5	5												
							350	10	5												
JANTXV2N2604	TO-46	80	60	6	10 @ 50	40	120	0.01	5	0.5	0.7	0.9	10	6	30	300	0.5		3	1	62
						60		0.5	5												
							350	10	5												

2N2605	TO-46	60	45	6	10	45	100 150 600	300	0.01 0.5 10	5 5 5	0.5	0.7	0.9	10	6	30		0.5		3	1	62
JAN2N2605	TO-46	70	60	6	10	50	100 150 600	300	0.010 0.5 10	5 5 5	0.5	0.7	0.9	10	6	30	300	0.5		3	1	62
JANTX2N2605	TO-46	70	60	6	10	50	100 150 600	300	0.01 0.5 10	5 5 5	0.5	0.7	0.9	10	6	30	300	0.5		3	1	62
JANTXV2N2605	TO-46	70	60	6	10	50	100 150 600	300	0.01 0.5 10	5 5 5	0.5	0.7	0.9	10	6	30	300	0.5		3	1	62
2N3547	TO-18	60	60	6	25	45	60 100 75	500	0.01 1 10	5 5 5	1		1	10	8	45	150	1		5	1	62
2N3548	TO-18	60	45	6	10	45	100 150 600	300	0.01 0.1 10	5 5 5	1		1	10	8	60	150	1		4	1	62
2N3549	TO-18	60	60	6	10	45	100 150 200	500	0.010 0.100 1	5 5 5	1		1	10	8	60	150	1		4	1	62
2N3550	TO-18	60	45	8	1	45	125 200 300	600	0.001 0.010 1	5 5 5	0.5	0.7	0.9	5	8	60	150	1		4	1	62
2N3799	TO-18	60	60	5	10	50	75 225 300 300 300	900	0.001 0.01 0.1 0.5 1	5 5 5 5 5	0.2 0.25		0.7 0.8	0.01 1	4	30		0.5		1.5 1.5 4 2.5	9 10 11 12	62
2N3962	TO-18	60	60	6	10	50	100 100	300 450	0.010 1.0	5 5	0.25		0.9	10	6	40	160	0.5		3 3 3 10	2 3 4 5	62
2N3963	TO-18	80	80	6	10	70	100 100	300 450	0.010 1.0	5 5	0.25		0.9	10	6	40	160	0.5		3 3 3 10	2 3 4 5	62
2N3964	TO-18	45	45	6	10	40	250 250	500 600	0.010 1	5 5	0.25		0.9	10	6	40	160	0.5		2 2 2 4	2 3 4 5	62
2N3965	TO-18	60	60	6	10	50	250 250	500 600	0.010 1	5 5	0.25		0.9	10	6	40	160	0.5		2 2 2 4	2 3 4 5	62
2N4058	TO-92(74)	30	30	6	100	20	100	400	0.1	5	0.7			10						5	13	62
2N4059	TO-92(74)	30	30	6	100	20	45	660	1	5	0.7			10								62
2N4061	TO-92(74)	30	30	6	100	20	90	330	1	5	0.7			10								62
2N4062	TO-92(74)	30	30	6	100	20	180	660	1	5	0.7			10								62
2N4248	TO-106	40	40	5	10	40	50		0.1	5	0.25			10	6							62
2N4249	TO-106	60	60	5	10	40	100	300	0.1	5	0.25			10	6					3 3 3	2 4 6	62

Test Conditions:

1. I_C = 10μA, V_{CE} = 5.0V, R_G = 10 kΩ, BW = 15.7 kHz
2. I_C = 20μA, V_{CE} = 5.0V, R_G = 10 kΩ, BW = 15.7 kHz
3. I_C = 20μA, V_{CE} = 5.0V, R_G = 10 kΩ, BW = 1.5 kHz, f = 10 kHz
4. I_C = 20μA, V_{CE} = 5.0V, f = 1.0 kHz, BW = 150 Hz, R_G = 10 kΩ
5. I_C = 20μA, V_{CE} = 5.0V, f = 100 Hz, BW = 15 Hz, R_G = 10 kΩ
6. I_C = 250μA, V_{CE} = 5.0V, R_G = 1.0 kΩ, BW = 150 Hz, f = 1.0 kHz
7. I_C = 10μA, V_{CE} = 5.0V, R_G = 10 kΩ, f = 1.0 kHz, BW = 200
8. I_C = 100μA, V_{CE} = 5.0V, R_S = 3.0k, f = 1.0 kHz
9. V_{CE} = 10V, I_C = 100μA, R_G = 3.0 kΩ, BW = 200 Hz, f = 1.0 kHz
10. V_{CE} = 10V, I_C = 100μA, R_G = 3.0 kΩ, f = 10 kHz, BW = 2.0 kHz
11. V_{CE} = 10V, I_C = 100μA, R_G = 3.0 kΩ, f = 100 Hz, BW = 20 Hz
12. V_{CE} = 10V, I_C = 100μA, R_G = 3.0 kΩ, BW = 15.7 Hz
13. V_{CE} = 5.0V, I_C = 100μA, R_G = 5.0 kΩ, BW = 15.7 kHz

PNP Transistors

LOW LEVEL AMPS (Cont.)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) @ V_{CB} (V) Max		h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(sat)}$ (V) & $V_{BE(sat)}$ (V) Max	Min	Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
2N4250	TO-106	40	40	5	10	40	250	700	0.1	5	0.25			10	6					2	2	62
																				2	4	
																				2	6	
2N4250A	TO-106	60	60	5	10	50	250	700	0.1	5	0.25			10	6					2	2	62
																				2	4	
																				2	6	
2N4288	TO-92(74)	30	25	6	50	25	100		0.1	5	0.35		0.8	1	8	40		1				62
							150	600	1	5												
							75		10	5												
2N4289	TO-92(74)	60	45	7	10	45	100		0.1	5	0.35		0.8	1	8	40		1		4	1	62
							150	600	1	5												
							75		10	5												
2N4964	TO-106	50	40	5	25	20	30	120	0.01	5	0.4			10	8	60		1		6	7	62
							40		10	5												
2N4965	TO-106	50	40	5	25	20	80	400	0.01	5	0.4			10	8	60		1		6	7	62
							100		10	5												
2N5086	TO-92(72)	50	50		50	35	150	500	0.1	5	0.3			10	4	40		0.5		3	8	62
							150		1	5										3	2	
							150		10	5												
2N5087	TO-92(72)	50	50		50	35	250	800	0.1	5	0.3			10	4	40		0.5		2	8	62
							250		1	5										2	2	
							250		10	5												
2N5227	TO-92(72)	30	30	3	100	10	30		0.1	10	0.4		1	10	5	100		10				62
							50	700	2	10												
MPS6523	TO-92(72)	25	25	4	50	20	150		0.1	10	0.5			50	4					3	3	62
							300	600	2	10												
MPSA70	TO-92(72)		40	4	100	30	40	400	5	10	0.25			10	4	125		5				62

Test Conditions:

1. I_C = 10μA, V_{CE} = 5.0V, R_G = 10 kΩ, BW = 15.7 kHz
2. I_C = 20μA, V_{CE} = 5.0V, R_G = 10 kΩ, BW = 15.7 kHz
3. I_C = 20μA, V_{CE} = 5.0V, R_G = 10 kΩ, BW = 1.5 kHz, f = 10 kHz
4. I_C = 20μA, V_{CE} = 5.0V, f = 1.0 kHz, BW = 150 Hz, R_G = 10 kΩ
5. I_C = 20μA, V_{CE} = 5.0V, f = 100 Hz, BW = 15 Hz, R_G = 10 kΩ
6. I_C = 250μA, V_{CE} = 5.0V, R_G = 1.0 kΩ, BW = 150 Hz, f = 1.0 kHz
7. I_C = 10μA, V_{CE} = 5.0V, R_G = 10 kΩ, f = 1.0 kHz, BW = 200
8. I_C = 100μA, V_{CE} = 5.0V, R_S = 3.0k, f = 1.0 kHz
9. V_{CE} = 10V, I_C = 100μA, R_G = 3.0 kΩ, BW = 200 Hz, f = 1.0 kHz
10. V_{CE} = 10V, I_C = 100μA, R_G = 3.0 kΩ, f = 10 kHz, BW = 2.0 kHz
11. V_{CE} = 10V, I_C = 100μA, R_G = 3.0 kΩ, f = 100 Hz, BW = 20 Hz
12. V_{CE} = 10V, I_C = 100μA, R_G = 3.0 kΩ, BW = 15.7 Hz
13. V_{CE} = 5.0V, I_C = 100μA, R_G = 5.0 kΩ, BW = 15.7 kHz

PNP Transistors

GENERAL PURPOSE AMPS AND SWITCHES

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) @ V_{CB} (V) Max		h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(sat)}$ (V) & $V_{BE(sat)}$ (V) Max	Min	Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
2N722	TO-18	50	35	5	1 μA	30	30	90	150	10	1.5		1.3	150	45	60		50				63
							25		5	10												
2N1132	TO-5	50	35	5	1 μA	30	25	100	1	5	1.5		1.3	150	45	60		50				63
							25*		5	10												

2N2696	TO-18	25	25	4	25	10	30 20	130	50 300	1 2	0.25 1		1.1 2	50 300	20	100	50	170		4	63
2N2904	TO-5	60	40	5	20	50	20 40 20	120	0.1 150 500	10 10 10	0.4 1.6		1.3 2.6	150 500	8	200	50				63
JAN2N2904	TO-5	60	40	5	20	50	20 25 35 40 20	120	0.1 1 10 150 500	10 10 10 10 10	0.4 1.6		1.3 2.6	150 500	8	200	50	175		1	63
JANTX2N2904	TO-5	60	40	5	20	50	20 40 20	120	0.1 150 500	10 10 10	0.4 1.6		1.3 2.6	150 500	8	200	50	175		1	63
JANTXV2N2904	TO-5	60	40	5	20	50	20 40 20	120	0.1 150 500	10 10 10	0.4 1.6		1.3 2.6	150 500	8	200	50	175		1	63
2N2904A	TO-5	60	60	5	10	50	40 40 40	120	0.1 150 500	10 10 10	0.4 1.6		1.3 2.6	150 500	8	200	50				63
JAN2N2904A	TO-5	60	60	5	10	50	40 40 40 40 40	120	0.1 1 10 150 500	10 10 10 10 10	0.4 1.6		1.3 2.6	150 500	8	200	50	175		1	63
JANTX2N2904A	TO-5	60	60	5	10	50	40 40 40	120	0.1 150 500	10 10 10	0.4 1.6		1.3 2.6	150 500	8	200	50	175		1	63
JANTXV2N2904A	TO-5	60	60	5	10	50	40 40 40	120	0.1 150 500	10 10 10	0.4 1.6		1.3 2.6	150 500	8	200	50	175		1	63
2N2905	TO-5	60	40	5	20	50	35 100 30	300	0.1 150 500	10 10 10	0.4 1.6		1.3 2.6	150 500	8	200	50				63
JAN2N2905	TO-5	60	40	5	20	50	35 50 75 100 30	300	0.1 1 10 150 500	10 10 10 10 10	0.4 1.6		1.3 2.6	150 500	8	200	50	200		1	63
JANTX2N2905	TO-5	60	40	5	20	50	50 100 30	300	0.1 150 500	10 10 10	0.4 1.6		1.3 2.6	150 500	8	200	50	200		1	63
JANTXV2N2905	TO-5	60	40	5	20	50	50 100 30	300	0.1 150 500	10 10 10	0.4 1.6		1.3 2.6	150 500	8	200	50	200		1	63
2N2905A	TO-5	60	60	5	10	50	75 100 50	300	0.1 150 500	10 10 10	0.4 1.6		1.3 2.6	150 500	8	200	50				63
JAN2905A	TO-5	60	60	5	10	50	75 100 100 100 50	300	0.1 1 10 150 500	10 10 10 10 10	0.4 1.6		1.3 2.6	150 500	8	200	50	200		1	63

Test Conditions:

1. I_C = 150 mA, V_{CC} = 30V, $I_{B1} = I_{B2}$ = 15 mA
2. I_C = 100μA, V_{CE} = 5.0V, R_G = 1.0 kΩ, BW = 15.7 kHz
3. I_C = 10μA, V_{CE} = 5.0V, R_G = 10 kΩ, W.B.
4. I_C = 300 mA, $I_{B1} = I_{B2}$ = 30 mA, V_{CC} = 10V
5. I_C = 30μA, V_{CE} = 15V, R_S = 10 kΩ, f = 1.0 kHz
6. I_C = 150 mA, $I_{B1} = I_{B2}$ = 15 mA
7. I_C = 300 mA, $I_{B1} = I_{B2}$ = 30 mA, V_{CC} = 30V
8. I_C = 10 mA, $I_{B1} = I_{B2}$ = 1.0 mA,
9. I_C = 50 mA, V_{CC} = 10V, $I_{B1} = I_{B2}$ = 5.0 mA
10. I_C = 300 mA, $I_{B1} = I_{B2}$ = 30 mA, V_{CC} = 15V

*Metal can equivalents of 2N3905 and 2N3906.

PNP Transistors

GENERAL PURPOSE AMPS AND SWITCHES (Cont.)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) @ V_{CB} (V) Max		h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max	& $V_{BE(sat)}$ (V) Min	$V_{BE(sat)}$ (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
JANTX2N2905A	TO-5	60	60	5	10	50	75		0.1	10	0.4		1.3	150	8	200		50	200		1	63
							100	300	150	10	1.6		2.6	500								
							50		500	10												
JANTXV2N2905A	TO-5	60	60	5	10	50	75		0.1	10	0.4		1.3	150	8	200		50	200		1	63
							100	300	150	10	1.6		2.6	500								
							50		500	10												
2N2906	TO-18	60	40	5	20	50	20		0.1	10	0.4		1.3	150	8	200		50				63
							40	120	150	10	1.6		2.6	500								
							20		500	10												
JAN2N2906	TO-18	60	40	5	20	50	20		0.1	10	0.4		1.3	150	8	200		50	175		1	63
							25		1	10	1.6		2.6	500								
							35		10	10												
							40	120	150	10												
							20		500	10												
JANTX2N2906	TO-18	60	40	5	20	50	20		0.1	10	0.4		1.3	150	8	200		50	175		1	63
							40	120	150	10	1.6		2.6	500								
							20		500	10												
JANTXV2N2906	TO-18	60	40	5	20	50	20		0.1	10	0.4		1.3	150	8	200		50	175		1	63
							20	140	150	10	1.6		2.6	500								
							20		500	10												
2N2906A	TO-18	60	60	5	20	50	40		0.1	10	0.4		1.3	150	8	200		50				63
							40	120	150	10	1.6		2.6	500								
							40		500	10												
JAN2N2906A	TO-18	60	60	5	10	50	40		0.1	10	0.4		1.3	150	8	200		50	175		1	63
							40		1	10	1.6		2.6	500								
							40		10	10												
							40	120	150	10												
							40		500	10												
JANTX2N2906A	TO-18	60	60	5	10	50	40		0.1	10	0.4		1.3	150	8	200		50	175		1	63
							40	120	150	10	1.6		2.6	500								
							40		500	10												
JANTXV2N2906A	TO-18	60	60	5	10	50	40		0.1	10	0.4		1.3	150	8	200		50	175		1	63
							40	120	150	10	1.6		2.6	500								
							40		500	10												
2N2907	TO-18	60	40	5	20	50	35		0.1	10	0.4		1.3	150	8	200		50			1	63
							100	300	150	10	1.6		2.6	500								
							30		500	10												
JAN2N2907	TO-18	60	40	5	20	50	35		0.1	10	0.4		1.3	150	8	200		50	200		1	63
							50		1	10	1.6		2.6	500								
							75		10	10												
							100	300	150	10												
							30		500	10												
JANTX2N2907	TO-18	60	40	5	20	50	35		0.1	10	0.4		1.3	150	8	200		50	200		1	63
							100	300	150	10	1.6		2.6	500								
							30		500	10												
JANTXV2N2907	TO-18	60	40	5	20	50	35		0.1	10	0.4		1.3	150	8	200		50	200		1	63
							100	300	150	10	1.6		2.6	500								
							30		500	10												
2N2907A	TO-18	60	60	5	20	50	75		1.0	10	0.4		1.3	150	8	200		50				63
							100	300	150	10	1.6		2.6	500								
							50		500	10												

JAN2N2907A	TO-18	60	60	5	10	50	75		0.1	10	0.4	1.3	150	8	200	50	200			1		63
							100		1	10	1.6	2.6	500									
							100		10	10												
							100	300	150	10												
							50		500	10												
JANTX2N2907A	TO-18	60	60	5	10	50	75		1	10	0.4	1.3	150	8	200	50	200			1		63
							100	300	150	10	1.6	2.6	500									
							50		500	10												
JANTXV2N2907A	TO-18	60	60	5	10	50	75		1	10	0.4	1.3	150	8	200	50	200			1		63
							100	300	150	10	1.6	2.6	500									
							50		500	10												
2N3072	TO-5	60	60	4			30	130	50	1	0.25	1.2	50	10	130	50	100			10		63
							15		300	2	1	2	300									
2N3073	TO-18	60	60	4			30	130	50	1	0.25	1.2	50	10	130	50	100			10		63
							15		300	2	1	2	300									
2N3120	TO-5	45	45	4			30	130	50	1	0.25	1.2	50	10	130	50	100			10		63
							15		300	2	0.5	2	500									
											1											
2N3121	TO-18	45	45	4			30	130	50	1	0.25	1.2	50	10	130	50	100			10		63
							15		300	2	0.5	2	500									
											1											
2N3133	TO-5	50	35	4	50	30	10		150	1	0.6	1.5	150	10	200	50						63
							25		1	10												
							40	120	150	10												
2N3134	TO-5	50	35	4	50	30	25		150	1	0.6	1.5	150	10	200	50						63
							50		1	10												
							100	300	150	10												
2N3135	TO-18	50	35	4	50	30	10		150	1	0.6	1.5	150	10	200	50						63
							25		1	10												
							40	120	150	10												
2N3136	TO-18	50	35	4	50	30	25		150	1	0.6	1.5	150	10	200	50						63
							50		1	10												
							100	300	150	10												
2N3502	TO-5	45	45	5	10	30	80		0.01	10	0.25	1	50	8	200	50	100			7		63
					I_{CES}		120		0.1	10	0.4	1.3	150					4		5		
							135		1	10	1	2	300									
							140		10	10	1.6	20	500									
							100	300	150	10												
							50		500	10												
							115	300	50	1												
2N3503	TO-5	60	60	5	10	50	80		0.01	10	0.25	1	50	8	200	50	100			7		63
					I_{CES}		120		0.1	10	0.4	1.3	150					4		5		
							135		1	10	1	2	300									
							140		10	10	1.6	20	500									
							100	300	150	10												
							50		500	10												
							115	300	50	1												

Test Conditions:

1. I_C = 150 mA, V_{CC} = 30V, $I_{B1} = I_{B2}$ = 15 mA
2. I_C = 100μA, V_{CE} = 5.0V, R_G = 1.0 kΩ, BW = 15.7 kHz
3. I_C = 10μA, V_{CE} = 5.0V, R_G = 10 kΩ, W.B.
4. I_C = 300 mA, $I_{B1} = I_{B2}$ = 30 mA, V_{CC} = 10V
5. I_C = 30μA, V_{CE} = 15V, R_S = 10 kΩ, f = 1.0 kHz
6. I_C = 150 mA, $I_{B1} = I_{B2}$ = 15 mA
7. I_C = 300 mA, $I_{B1} = I_{B2}$ = 30 mA, V_{CC} = 30V
8. I_C = 10 mA, $I_{B1} = I_{B2}$ = 1.0 mA,
9. I_C = 50 mA, V_{CC} = 10V, $I_{B1} = I_{B2}$ = 5.0 mA
10. I_C = 300 mA, $I_{B1} = I_{B2}$ = 30 mA, V_{CC} = 15V

*Metal can equivalents of 2N3905 and 2N3906.

PNP Transistors

GENERAL PURPOSE AMPS AND SWITCHES (Cont.)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) @ V_{CB} (V) Max	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max	& $V_{BE(sat)}$ (V) Min	$V_{BE(sat)}$ (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
2N3504	TO-18	45	45	5	10 30 I_{CES}	80		0.01	10	0.25		1	50	8	200		50	100		7	63
						120		0.1	10	0.4		1.3	150						4	5	
						135		1	10	1		2	300								
						140		10	10	1.6		20	500								
						100	300	150	10												
						50		500	10												
						115	300	50	1												
2N3505	TO-18	60	60	5	10 50 I_{CES}	80		0.01	10	0.25		1	50	8	200		50	100		7	63
						120		0.1	10	0.4		1.3	150						4	5	
						135		1	10	1		2	300								
						140		10	10	1.6		20	500								
						100	300	150	10												
						50		500	10												
						115	300	50	1												
2N3638	TO-105	25	25	4	35 15	30		50	2	1	0.8	2	300	20	100		50	170		4	63
						20		300	1	0.25		1.1	50								
2N3638A	TO-105	25	25	4	35 15	80		1	2	1	0.8	2	300	10	150		50	170		4	63
						100		10	1	0.15		1.1	50								
						100		50	10												
						20		300	10												
2N3644	TO-105	45	45	5	35 30	40		0.1	10	1	0.8	2	300	8	200		20	100		7	63
						80		1	10												
						100		10	10												
						115	300	50	10												
						100	300	150	2												
						20		300	1												
2N3645	TO-105	60	60	5	35 50	40		0.1	10	1	0.8	2	300	8	200		20	100		7	63
						80		1	10	0.25		1	50								
						100		10	10												
						115	300	50	10												
						100	300	150	2												
						20		300	1												
2N3702	TO-92(74)	40	25	5	100 20	60	300	50	5	0.25			50	12	100		50				63
2N3703	TO-92(74)	50	30	5	100 20	30	150	50	5	0.25			50	12	100		50				63
2N3905	TO-92(72)	40	40	5		30		0.1	1	0.25	0.65	0.65	10	4.5	200		10		5	2	66
						40		1	1	0.4		0.95	50								
						50	150	10	1												
						30		50	1												
						15		100	1												
2N3906	TO-92(72)	40	40	5		60		0.1	1	0.25	0.65	0.85	10	4.5	250		10		4	2	66
						80		1	1	0.4		0.95	50								
						100	300	10	1												
						60		50	1												
						30		100	1												
2N4121	TO-106	40	40	5		40		0.1	1	0.13		0.75	1.0	4.5	400		10		4	2	66
						60		1	1	0.14	0.7	0.9	10								
						70	200	10	1	0.3		1.1	50								
						15		50	1												
2N4122	TO-106	40	40	5		100		0.1	1	0.13		0.75	1.0	4.5	450		10		4	2	66
						150		1	1	0.14	0.7	0.9	10								
						150	300	10	1	0.3		1.1	50								
						30		50	1	0.4			50								

2N4125	TO-92(72)	30	30	4	50	20	50	150	2	1	0.4		0.95	50	4.5	200	10		5	2	66
							25		50	1											
2N4126	TO-92(72)	25	25	4	50	20	120	360	2	1	0.4		0.95	50	4.5	250	10		4	2	66
							60		50	1											
2N4142	TO-106	60	40	5	50	30	20		0.1	10	0.4		1.3	150	8	200	50				63
							25		1	10											
							35		10	10											
							20		150	1											
							40	120	150	10											
							20		500	1											
2N4143	TO-106	60	40	5	50	30	35		0.1	10	0.4		1.3	150	8	200	50				63
							50		1	10											
							75		10	10											
							50		150	1											
							100	300	150	10											
							30		500	1											
2N4228	TO-106	60	40	5	50	30	25		0.1	10	0.4		1.3	150	8	200	50				63
							50		10	10											
							30		150	1											
							75	150	150	10											
							20		500	1											
2N4290	TO-92(74)	30	20	5	500	20	20		0.1	10	0.4		1.5	100	10	100	10				63
							40		10	10											
							50	300	100	10											
2N4291	TO-92(74)	40	30	6	200	30	30		0.1	10	0.4		1.5	100	10	100	10				63
							50		10	10											
							100	300	100	10											
2N4402	TO-92(72)	40	40	5			30		1	1	0.4	0.75	0.95	150		150	20	255		1	63
							50		10	1	0.75		1.3	500							
							50	150	150	1											
							20		500	2											
2N4403	TO-92(72)	40	40	5			30		0.1	1	0.4	0.75	0.95	150		200	20	255		1	63
							60		1	1	0.75		1.2	500							
							100		10	1											
							100	300	150	1											
							20		500	2											
2N4916	TO-106	30	30	5			40		0.1	1	0.13		0.75	1	4.5	400	10		4	2	66
							60		1	1	0.14	0.7	0.9	10							
							70	200	10	1	0.3	0.75	1.1	50							
							15		50	1											
2N4917	TO-106	30	30	5			100		0.1	1	0.13		0.75	1	4.5	450	10	150		9	66
							150		1	1	0.14	0.7	0.9	10							
							150	300	10	1	0.3	0.75	1.1	50							
							30		50	1											
2N4971	TO-106	50	40	5	25	30	30		10	10	0.15		1.3	150	8	200	50	150		9	63
							20		150	1									4	2	
							40	120	150	10											
2N4972	TO-106	50	40	5	25	30	70		10	10	0.4		1.3	150	8	200	50				63
							50		150	1											
							100	300	150	10											
2N5138	TO-106	30	30	5	50	20	50	800	0.1	10	0.3		1	10	7	30	5				66
							50		1	10											
							50		10	10											

Test Conditions:

1. I_C = 150 mA, V_{CC} = 30V, $I_{B1} = I_{B2}$ = 15 mA
2. I_C = 100μA, V_{CE} = 5.0V, R_G = 1.0 kΩ, BW = 15.7 kHz
3. I_C = 10μA, V_{CE} = 5.0V, R_G = 10 kΩ, W.B.
4. I_C = 300 mA, $I_{B1} = I_{B2}$ = 30 mA, V_{CC} = 10V
5. I_C = 30μA, V_{CE} = 15V, R_S = 10 kΩ, f = 1.0 kHz
6. I_C = 150 mA, $I_{B1} = I_{B2}$ = 15 mA
7. I_C = 300 mA, $I_{B1} = I_{B2}$ = 30 mA, V_{CC} = 30V
8. I_C = 10 mA, $I_{B1} = I_{B2}$ = 1.0 mA,
9. I_C = 50 mA, V_{CC} = 10V, $I_{B1} = I_{B2}$ = 5.0 mA
10. I_C = 300 mA, $I_{B1} = I_{B2}$ = 30 mA, V_{CC} = 15V

*Metal can equivalents of 2N3905 and 2N3906.

PNP Transistors

GENERAL PURPOSE AMPS AND SWITCHES (Cont.)

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) @ V_{CB} (V) Max	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max	& $V_{BE(sat)}$ (V) Min	$V_{BE(sat)}$ (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
2N5139	TO-106	20	20	5	50 @ 15	30		0.1	10	0.5	0.7	1	50	5	300		10				66
						40		1	10												
						40		10	1												
2N5142	TO-105	20	20	4	50 @ 12	30		50	1	2	0.8	2.5	300	10	100		50	200		4	63
						15		300	10	0.5		1.5	50								
2N5143	TO-106	20	20	4	50 @ 12	30		50	1	2	0.8	2.5	300	10	100		50	200		4	63
						15		300	10	0.5		1.5	50								
2N5221	TO-92(72)	15	15	3	100 @ 10	25		10	10	0.5		1.1	150	15	100		20				63
						30	600	50	10												
2N5226	TO-92(72)	25	25	4	300 @ 15	25		10	10	0.8		1	100	20	50		20				63
						30	600	50	10												
2N5354	TO-92(74)	25	25	4	100 @ 25	40	120	50	1	0.25			50	8							63
2N5355	TO-92(74)	25	25	4	100 @ 25	100	300	50	1	0.25			50	8							63
2N5356	TO-92(74)	25	25	4	100 @ 25	250	500	50	1	0.25			50	8							63
2N5365	TO-92(74)	40	40	4	100 @ 40	40	120	50	1	0.25			50	8							63
2N5366	TO-92(74)	40	40	4	100 @ 40	100	300	50	1	0.25			50	8							63
EN722	TO-106	50	35		1000 @ 30	25		5	10	1.5		1.3	150	45	60		50				63
						30	90	150	10												
EN1132	TO-105	50	35		1000 @ 30	25		5	10	1.5		1.3	150	45	60		50				63
						30	90	150	10												
EN2905	TO-105	60	40		50 @ 50	35		0.1	10	0.4		1.3	150	8	150		50	110		6	63
						100	300	150	10	1		2	300								
						30		500	10												
EN2907	TO-106	60	40	5	50 @ 50	35		0.1	10	0.4		1.3	150	8	150		50	110		6	63
						100	300	150	10	1		2	300								
						30		500	10												
EN3250	TO-106	50	40	5	50 @ 40 I_{CEX}	40		0.1	1	0.25	0.6	0.9	10	6	250		10	225		8	66
						45		1	1	0.5		1.2	50								
						50	150	10	1												
						15		50	1												
EN3502	TO-105	45	45	5	10 @ 30 I_{CES}	80		0.01	10	0.25		1	50	8	150		50	100		7	63
						120		0.1	10	0.4		1.3	150						4	5	
						135		1	10	1		2	300								
						140		10	10												
						115	300	50	1												
						100	300	150	10												
						30		500	10												
EN3504	TO-106	45	45	5	10 @ 30 I_{CES}	80		0.01	10						150		50	100		7	63
						120		0.1	10										4	5	
						135		1	10												
						140		10	10												
						115	300	50	1												
						100	300	150	10												
						30		500	10												
MPS3638	TO-92(72)	25	25	4		20		10	10	0.25		1.1	50	20	100		50	170		4	63
						30		50	1												
						20		300	2												
MPS3638A	TO-92(72)	25	25	4		80		1	10	0.25		1.1	50	10	150		50	170		4	63
						100		10	10	1	0.8	2	300								
						100		50	1												
						20		300	2												

MPS3644	TO-92(72)	45	45	5	35 I_{CES}	30	40 80 100 100 20 115	 300 300	0.1 1 10 150 300 50	10 10 10 10 2 1	0.25 0.4 1	 0.8	1 1.3 2	50 150 300	8	200	20	100		7	63
MPS3645	TO-92(72)	60	60	5	35 I_{CES}	50	40 80 100 100 20 80	 300 240	0.1 1 10 150 300 50	10 10 10 10 2 1	0.25 0.4 1	 0.8	1 1.3 2	50 150 300	8	200	20	100		7	63
MPS3702	TO-92(72)	40	25	5	100	20	60	300	50	5	0.25			50	12	100	50				63
MPS3703	TO-92(72)	50	30	5	100	20	30	150	50	5	0.25			50	12	100	50				63
MPS6516	TO-92(72)	40	40	4	50	30	50 30	100	2 100	10 10	0.5			50	4						66
MPS6517	TO-92(72)	40	40	4	50	30	90 60	180	2 100	10 10	0.5			50	4						66
MPS6518	TO-92(72)	40	40	4	500	30	150 90	300	2 100	10 10	0.5			50	4						66
MPS6522	TO-92(72)	25	25	4	50	20	100 200	 400	0.1 2	10 10	0.5			50	4				3	3	66
MPS6533	TO-92(72)	40	40	4	50	30	30 40 25	 120 	10 100 500	1 1 10	0.5		1	100	6						63
MPS6534	TO-92(72)	40	40	4	50	30	60 90 50	 270 	10 100 500	1 1 10	0.3		1	100	6						63
MPS6535	TO-92(72)	30	30	4	100	20	30		100	1	0.5		1.2	100	6						63
NS3905*	TO-18	40	40	5	50 (I_{CEX})	30	30 40 50 30 15	 150 	0.1 1 10 50 100	1 1 1 1 1	0.25 0.4	0.65	0.85 0.95	10 50	4.5	200	10	260	5	8 2	66
NS3906*	TO-18	40	40	5	50 (I_{CEX})	30	60 80 100 60 30	 300 	0.1 1 10 50 100	1 1 1 1 1	0.25 0.4	0.65	0.85 0.95	10 50	4.5	250	10	300	4	8 2	66
PN2906	TO-92(72)	60	40	5	20	50	20 40 20	 120 	0.1 150 500	10 10 10	0.4 1.6		1.3 2.6	150 500	8	200	50				63
PN2906A	TO-92(72)	60	60	5	10	50	40 40 40	 120 	0.1 150 500	10 10 10	0.4 1.6		1.3 2.6	150 500	8	200	50				63
PN2907	TO-92(72)	60	40	5	20	50	35 100 30	 300 	0.1 150 500	10 10 10	0.4 1.6		1.3 2.6	150 500	8	200	50				63
PN2907A	TO-92(72)	60	60	5	10	50	75 100 50	 300 	0.1 150 500	10 10 10	0.4 1.6		1.3 2.6	150 500	8	200	50				63

Test Conditions:

1. I_C = 150 mA, V_{CC} = 30V, $I_{B1} = I_{B2}$ = 15 mA
2. I_C = 100μA, V_{CE} = 5.0V, R_G = 1.0 kΩ, BW = 15.7 kHz
3. I_C = 10μA, V_{CE} = 5.0V, R_G = 10 kΩ, W.B.
4. I_C = 300 mA, $I_{B1} = I_{B2}$ = 30 mA, V_{CC} = 10V
5. I_C = 30μA, V_{CE} = 15V, R_S = 10 kΩ, f = 1.0 kHz
6. I_C = 150 mA, $I_{B1} = I_{B2}$ = 15 mA
7. I_C = 300 mA, $I_{B1} = I_{B2}$ = 30 mA, V_{CC} = 30V
8. I_C = 10 mA, $I_{B1} = I_{B2}$ = 1.0 mA,
9. I_C = 50 mA, V_{CC} = 10V, $I_{B1} = I_{B2}$ = 5.0 mA
10. I_C = 300 mA, $I_{B1} = I_{B2}$ = 30 mA, V_{CC} = 15V

*Metal can equivalents of 2N3905 and 2N3906.

PNP Transistors

MEDIUM POWER AMPS

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) @ Max	V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(sat)}$ (V) Max	& $V_{BE(sat)}$ (V) Min	$V_{BE(sat)}$ (V) Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
40319	TO-39		40	2.5	250	15	35	200	50	4	1.4			150								67
2N4030	TO-39	60	60	5	50	50	30		0.10	5	0.15		0.9	150	20	100		50	400*		2	67
							40	120	100	5	0.5		1.1	500		400						
							15		1A	5	1.0		1.2	1000								
2N4031	TO-39	80	80	5	50	60	30		0.1	5	0.15		0.9	150	20	100		50	400*		2	67
							40	120	100	5	0.5		1.1	500		400						
							10		1A	5												
2N4032	TO-39	60	60	5	50	50	75		0.1	5	0.15		0.9	150	20	150		50	400*		2	67
							100	300	100	5	0.5		1.1	500		500						
							40		1A	5	1.0		1.2	1000								
2N4033	TO-39	80	80	5	50	60	75		0.1	5	0.15		0.9	150	20	150		50	400*		2	67
							100	300	100	5	0.5		1.1	500		500						
							25		1A	5												
2N4036	TO-39	90	65	7	100	90	20	200	150	2	0.65		1.4	150		60		50	700		3	67
							20		0.1	10												
							40	140	150	10												
							20		500	10												
2N4037	TO-39	60	40	7	250	60	15		1	10	1.4				30	60		200	50			67
							50	250	150	10												
2N4234	TO-39	40	40	7	100 μA	40	10		1A	1	0.6		1.5	1A	100	3		100				67
							30	150	250	1			1*	250								
							40		100	1												
							20		500	1												
2N4235	TO-39	60	60	7	100 μA	60	10			1	0.6		1.5	1A	100	3		100				67
							30	150	1A	1			1*	250								
							40		250	1												
							20		100	1												
									500													
2N4236	TO-39	80	80	7	100 μA	80	10		1A	1	0.6		1.5	1A	100	3		100				67
							30	150	250	1			1*	250								
							40		100	1												
							20		500	1												
2N4314	TO-39	90	65		250	60	50	250	150	10	1.4		1.5*	150	30	60	200	50				67
							15		1	10												
2N4354	TO-105	60	60	5	50	50	25		0.1	10	0.15		0.9	150	30	100	500	50		3	1	67
							40		1	1												
							50	500	10	10												
							40		100	10												
							30		500	10												
2N4355	TO-105	60	60	5	50	50	60		0.1	10	0.15		0.9	150	30	100	500	50		3	1	67
							75		1	10												
							100	400	10	10												
							75		100	10												
							75		500	10												
2N4356	TO-105	80	80	5	50	59	25		0.1	10	0.15		0.9	150	30	100	500	50		3	1	67
							40		1	10												
							50	250	10	10												
							40		100	10												
							30		500	10												
CS9012	TO-105		25	3			64	202	50	1	1.0			250								60
MPSA55	TO-92(72)		60	4	100	60	50		10	1	0.25			100		50		100				67
							50		100	1												

MPSA56	TO-92(72)		80	4	100	80	50		10	1	0.25		100		50		100					67
							50		100	1												
MPS4354	TO-92(72)	60	60	5	50	50	25		0.1	10	0.15	0.9	150	30	100	500	50	400		2		67
							40		1	10	0.5	1.1	500						3	1		
							50	500	10	10												
							40		100	10												
							30		500	10												
MPS4355	TO-92(72)	60	60	5	50	50	60		0.1	10	0.15	0.9	150	30	100	500	50	400		2		67
							75		1	10	0.5	1.1	500						3	1		
							100	400	10	10												
							75		100	10												
							75		500	10												
MPS4356	TO-92(72)	80	80	5	50	50	25		0.1	10	0.15	0.9	150	30	100	500	50	400		2		67
							40		1	10	0.5	1.1	500						3	1		
							50	250	10	10												
							40		100	10												
							30		500	10												
MPS6562	TO-92(72)			5	100	20	35		10	1	0.5		500	30	60		10					67
							50		100	1												
							50	200	500	1												
MPS6563	TO-92(72)			5	100	20	35		10	1	0.5		350	30	60		10					67
							50		100	1												
							50	200	350	1												

Test Conditions:

1. I_C = 100μA, V_{CE} = 10V, R_G = 1.0 kΩ, BW = 1.0 Hz, f = 1.0 kHz
2. V_{CC} = 30V, I_C = 500 mA, $I_{B1} = I_{B2}$ = 50 mA,
3. I_C = 150 mA, V_{CC} = 30V, $I_{B1} = I_{B2}$ = 15 mA

(*$t_s + t_f$)

PNP Transistors

DUAL DIFFERENTIAL AMPS

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max @	V_{CB} (V)	h_{FE} Min	h_{FE} Max @	I_C (mA) &	V_{CE} (V)	h_{FE1} / h_{FE2} (%) Max	$V_{BE_1} - V_{BE_2}$ (mV) Max	$\Delta V_{BE1} - V_{BE2}$ / ΔT (μV/°C) Max	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max @	I_C (mA)	NF (dB) Max	Test Condition	Process No.
2N3347	TO-78	60	45	6	10	45	40	300	0.01		10	5	10	6	60	240		4	1	62
							60		1											
2N3348	TO-78	60	45	6	10	45	40	300	0.01		20	10	20	6	60	240		4	1	62
							60		1											
2N3349	TO-78	60	45	6	10	45	40	300	0.01		40	20	40	6	60	240		4	1	62
							60		1											
2N3350	TO-78	60	45	6	10	45	100	300	0.01		10	5	10	6	60	240		4	1	62
							150		1											
2N3351	TO-78	60	45	6	10	45	100	300	0.01		20	10	20	6	60	240		4	1	62
							150		1											
2N3352	TO-78	60	45	6	10	45	100	300	0.01		40	20	40	6	60	240		4	1	62
							150		1											

Test Conditions:

1. I_E = 10μA, V_{CE} = 5.0V, R_G = 10 kΩ, BW = 15.7 kHz
2. I_C = 100μA, V_{CE} = 5.0V, R_G = 3.0 kΩ, f = 100 Hz, BW = 20 Hz
3. I_C = 100μA, V_{CE} = 10V, R_G = 3.0 kΩ, f = 1.0 kHz, BW = 200 Hz
4. I_C = 100μA, V_{CE} = 10V, R_G = 3.0 kΩ, f = 10 kHz, BW = 2.0 kHz
5. I_C = 100μA, V_{CE} = 10V, R_G = 3.0 kΩ, BW = 15.7 kHz
6. I_C = 100μA, V_{CE} = 10V, R_G = 3.0 kΩ, f = 100 Hz, BW = 20 Hz
7. I_C = 30μA, V_{CE} = 5.0V, R_G = 10 kΩ, f = 2.0 kHz, BW = 200 Hz
8. I_C = 30μA, V_{CE} = 5.0V, R_G = 10 kΩ, f = 1.0 kHz, BW = 200 Hz
9. I_C = 20μA, V_{CE} = 5.0V, R_G = 10 kΩ, f = 1.0 kHz, BW = 150 Hz
10. I_C = 20μA, V_{CE} = 5.0V, R_G = 10 kΩ, f = 100 Hz, BW = 15 Hz
11. I_C = 20μA, V_{CE} = 5.0V, R_G = 10 kΩ, f = 100 Hz, BW = 15 Hz

DUAL DIFFERENTIAL AMPS (Cont.)

NPN Transistors

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} Min	h_{FE} Max	@ I_C (mA)	& V_{CE} (V)	h_{FE1} h_{FE2} (%) Max	$V_{BE_1} - V_{BE_2}$ (mV) Max	$\Delta V_{BE1} - V_{BE2}$ ΔT ($\mu V/°C$) Max	C_{ob} (pF) Max	f_T (MHz) Min	f_T (MHz) Max	@ I_C (mA)	NF (dB) Max	Test Condition	Process No.
2N3726	TO-78	45	45	5	10	30	80		0.01	5	10	5	20	8	200	600	50	4	8	62
							120		0.1	5										
							135	350	1	5										
							115		50	5										
2N3727	TO-78	45	45	5	10	30	80		0.01	5	10	2.5	10	8	200	600	50	4	8	62
							120		0.1	5										
							135	350	1	5										
							115		50	5										
2N3806	TO-78	60	60	5	10	50	100		0.01					4	100	500		7	2	62
							150	450	0.1									3	3	
							150	450	1									2.5	4	
																		3.5	5	
2N3807	TO-78	60	60	5	10	50	225		0.01					4	100	500		4	2	62
							300	900	0.1									1.5	3	
							300	900	1									1.5	4	
																		2.5	5	
2N3808	TO-78	60	60	5	10	50	100		0.01			8		4	100	500		7	6	62
							150	450	0.1		20	5	20					3	3	
							150	450	1			8						2.5	4	
																		3.5	5	
2N3809	TO-78	60	60	5	10	50	225		0.01			8		4	100	500		4	6	62
							300	900	0.1		20	5	20					1.5	3	
							300	900	1			8						1.5	4	
																		2.5	5	
2N3810	TO-78	60	60	5	10	50	100		0.01			5		4	100	500		7	6	62
							150	450	0.1		10	3	10					3	3	
							150	450	1			5						2.5	4	
																		3.5	5	
JAN2N3810	TO-78	60	60	5	10	50	100		0.01			5	10	5	100	500		7	6	62
							150	450	0.1		10	3						3	3	
							150	450	0.5									2.5	4	
							150	450	1									3.5	5	
							125		10											
JANTX2N3810	TO-78	60	60	5	10	50	100		0.01			5		5	100	500		7	6	62
							150	450	0.1		10	3	10					3	3	
							150	450	0.5									2.5	4	
							150	450	1									3.5	5	
							125		10			5								
JANTXV2N3810	TO-78	60	60	5	10	50	100		0.01			5		5	100	500		7	6	62
							150	450	0.1		10	3	10					3	3	
							150	450	0.5									2.5	4	
							150	450	1									3.5	5	
							125		10			5								
2N3810A	TO-78	60	60	5	10	50	100		0.01			5		4	100	500		7	2	62
							150	450	0.1		5	1.5	5					3	3	
							150	450	1			5						2.5	4	
																		3.5	5	
2N3811	TO-78	60	60	5	10	50	225		0.01			5		4	100	500		4	2	62
							300	900	0.1		10	3	10					1.5	3	
							300	900	1			5						1.5	4	
																		2.5	5	

JAN2N3811	TO-78	60	60	5	10	50	75		0.001				10	5	100	500	4	6	62
							225		0.01		5						1.5	3	
							300	900	0.1	10	3						1.5	4	
							300	900	0.5								2.5	5	
							300	900	1										
							250		10										
JANTX2N3811	TO-78	60	60	5	10	50	75		0.001						100	500	4	6	62
							225		0.01		5						1.5	3	
							300	900	0.1	10	3		10	5			1.5	4	
							300	900	0.5								2.5	5	
							300	900	1										
							250		10		5								
JANTXV2N3811	TO-78	60	60	5	10	50	75		0.001						100	500	4	6	62
							225		0.01		5						1.5	3	
							300	900	0.1	10	3		10	5			1.5	4	
							300	900	0.5								2.5	5	
							300	900	1										
							250		10		5								
2N3811A	TO-78	60	60	5	10	50	225		0.01		5			4	100	500	4	2	62
							300	900	0.1	5	1.5		5				1.5	3	
							300	900	1		5						1.5	4	
																	2.5	5	
2N4015	TO-78	60	60	5	10	50	80		0.01					8	200	600	4	8	62
							120		0.1	10	5		20						
							135	350	1	10	5		20						
							120		50										
2N4016	TO-78	60	60	5	10	50	80		0.01					8	200	600	4	9	62
							120		0.1	10	2		10						
							135	350	1	10	2		10						
							120		50										
2N4017	TO-78	80	80	6	10	70	100	350	0.01					6	40	160	3	10	62
							100		0.1								10	11	
							90		50										
2N4018	TO-78	60	60	6	10	50	100	500	0.01					6	40	160	3	10	62
							100		0.1								10	11	
							90		50										
2N4019	TO-78	45	45	6	10	30	250	500	0.01					6	50	160	2	10	62
							250		0.1								4	11	
							180		50										
2N4020	TO-78	45	45	6	10	30	250	500	0.01					6	50	160	4	10	62
							250	550	0.1	20	5		20				2	11	
							250	600	1	20	10								
							180		50										
2N4021	TO-78	60	60	6	10	50	100	350	0.01					6	40	160	10	10	62
							100	400	0.1	20	5		20				3	11	
							100	500	1	20	10								
							90		50										
2N4023	TO-78	45	45	6	10	30	250	500	0.01					6	50	160	4	11	62
							250	550	0.1	10	3		10				2	10	
							250	600	1	10	5								
							180		50										
2N4024	TO-78	60	60	6	10	50	100	350	0.01					6	40	160	10	11	62
							100	400	0.1	10	3		10				3	10	
							100	500	1	10	5								
							90		50										

Test Conditions:

1. I_E = 10μA, V_{CE} = 5.0V, R_G = 10 kΩ, BW = 15.7 kHz
2. I_C = 100μA, V_{CE} = 5.0V, R_G = 3.0 kΩ, f = 100 Hz, BW = 20 Hz
3. I_C = 100μA, V_{CE} = 10V, R_G = 3.0 kΩ, f = 1.0 kHz, BW = 200 Hz
4. I_C = 100μA, V_{CE} = 10V, R_G = 3.0 kΩ, f = 10 kHz, BW = 2.0 kHz
5. I_C = 100μA, V_{CE} = 10V, R_G = 3.0 kΩ, BW = 15.7 kHz
6. I_C = 100μA, V_{CE} = 10V, R_G = 3.0 kΩ, f = 100 Hz, BW = 20 Hz
7. I_C = 30μA, V_{CE} = 5.0V, R_G = 10 kΩ, f = 2.0 kHz, BW = 200 Hz
8. I_C = 30μA, V_{CE} = 5.0V, R_G = 10 kΩ, f = 1.0 kHz, BW = 200 Hz
9. I_C = 20μA, V_{CE} = 5.0V, R_G = 10 kΩ, f = 1.0 kHz, BW = 150 Hz
10. I_C = 20μA, V_{CE} = 5.0V, R_G = 10 kΩ, f = 100 Hz, BW = 15 Hz
11. I_C = 20μA, V_{CE} = 5.0V, R_G = 10 kΩ, f = 100 Hz, BW = 15 Hz

HIGH VOLTAGE

PNP Transistors

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) @ V_{CB} (V) Max		h_{FE} Min	Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(sat)}$ (V) & $V_{BE(sat)}$ (V) Max	Min	Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
2N3634	TO-39	140	140	5	100	100	40		0.1	10	0.3		0.8	10	10	150		30	600		1	73
							45		1	10	0.5	0.65	0.9	50								
							50		10	10												
							50	150	50	10												
							25		150	10												
2N3635	TO-39	140	140	5	100	100	80		0.1	10	0.3		0.8	10	10	200		30	600		1	73
							90		1	10	0.5	0.65	0.9	50								
							100		10	10												
							100	300	50	10												
							50		150	10												
2N3636	TO-39	175	175	5	100	100	40		0.1	10	0.2		0.8	10	10	150		30	600		1	73
							45		1	10	0.5	0.65	50									
							50		10	10												
							50	150	50	10												
							25		150	10												
2N3637	TO-39	175	175	5	100	100	80		0.1	10	0.3		0.8	10	10	200		30	600		1	73
							90		1	10	0.5	0.65	0.9	50								
							100		10	10												
							100	300	50	10												
							50		150	10												
2N5400	TO-92(72)	130	120	5	100	100	30		1	5	0.2		1	10	6	100	400	10		8	2	74
							40	180	10	5	0.5		1	50								
							40		50	5												
2N5401	TO-92(72)	160	150	5	50	120	50		1	5	0.2		1	10	6	100	300	10		8	2	74
							60	240	10	5	0.5		1	50								
							50		50	5												
MPSL51	TO-92(72)	100	100	4	1 μA	50	40	250	50	5	0.25		1.2	10	8	60						74
											0.3		1.2	50								

DURAWATT

PNP Transistors

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) @ V_{CB} (V) Max		h_{FE} Min	Max	@ I_C (mA)	& V_{CE} (V)	$V_{CE(sat)}$ (V) & $V_{BE(sat)}$ (V) Max	Min	Max	@ I_C* (mA)	C_{ob} @ V_{CB} = 10V (pF) Max	f_T (MHz) Min	Max	@ I_C (mA)	Process No.
NSD202	TO-202(35)	60	45	5	50	40	50		10	5	0.2		1.0	100	18	150		50	67
							50	150	100	5	0.4		1.2	500					
							40		500	5									
							25		1A	5									
NSD203	TO-202(35)	60	45	5	50	40	50		10	5	0.2		1.0	100	18	150		50	67
							120	350	100	5	0.4		1.2	500					
							50		500	5									
							25		1A	5									
NSD204	TO-202(35)	80	80	5	50	60	50		10	5	0.2		1.0	100	18	150		50	67
							50	150	100	5	0.4		1.2	500					
							40		500	5									
							25		1A	5									

NSD205	TO-202(35)	80	80	5	50	60	50 120 50 25	350	10 100 500 1A	5 5 5 5	0.2 0.4		1.0 1.2	100 500	18	150		50	67
NSD206	TO-202(35)	100	100	5	50	60	50 50 40 25	150	10 100 500 1A	5 5 5 5	0.2 0.4		1.0 1.2	100 500	18	150		50	67

•$I_C/I_B = 10$

SWITCHES/CHOPPERS

N-Channel FETs

Type No.	Case Style	BV_{GSS} *BV_{GDO} (V) Min	@ I_G (μA)	I_{GSS} *I_{DGO} (nA) Max	@ V_{DG} (V)	$I_{D(off)}$ (nA) Max	@ V_{DS} (V)	V_{GS} (V)	V_p (V) Min	Max	@ V_{DS} (V)	I_D (nA)	I_{DSS} (mA) Min	Max	@ V_{DS} (V)	$r_{ds(on)}$ (Ω) Max	@ I_D (mA)	C_{iss} (pF) Max	@ V_{DS} (V)	V_{GS} (V)	C_{rss} (pF) Max	@ V_{DS} (V)	V_{GS} (V)	t_{on} (ns) Max	t_{off} (ns) Max	Process No.
2N3824	TO-72	50	1	0.1	30	0.1	15	−8		8	15	.1				250		6	15	0	3	0	−8			55
2N3966	TO-72	30	1	1	20	0.1	10	−7	4	6	10	10	2		20	220		6	20	0	1.5	0	−7			50
2N3970	TO-18	40	1	0.25*	20	0.25	20	−12	4	10	20	1	50	150	20	30	1	25	20	0	6	0	−12	20	30	51
2N3971	TO-18	40	1	0.25*	20	0.25	20	12	2	5	20	1	25	75	20	60	1	25	20	0	6	0	−12	30	60	51
2N3972	TO-18	40	1	0.25*	20	0.25	20	−12	0.5	3	20	1	5	30	20	100	1	25	20	0	6	0	−12	80	100	51
•2N4091	TO-18	40	1	0.2*	20	0.2	20	−12	5	10	20	1	30		20	30	1	16	20	0	5	0	−20	25	40	51
•2N4092	TO-18	40	1	0.2*	20	0.2	20	−8	2	7	20	1	15		20	50	1	16	20	0	5	0	−20	35	60	51
•2N4093	TO-18	40	1	0.2*	20	0.2	20	−6	1	5	20	1	8		20	80	1	16	20	0	5	0	−20	60	80	51
2N4391	TO-18	40	1	0.1	20	0.1	20	−12	4	10	20	1	50	150	20	30	1	14	20	0	3.5	0	−12	20	35	51
2N4392	TO-18	40	1	0.1	20	0.1	20	−7	2	5	20	1	25	75	20	60	1	14	20	0	3.5	0	−7	20	55	51
2N4393	TO-18	40	1	0.1	20	0.1	20	−5	0.5	3	20	1	5	30	20	100	1	14	20	0	3.5	0	−5	20	80	51
•2N4856	TO-18	40	1	0.25	20	0.25	15	−10	4	10	15	.5	50		15	25		18	0	−10	8	0	−10	9	25	51
2N4856A	TO-18	40	1	0.25	20	0.25	15	−10	4	10	15	.5	50		15	25		10	0	−10	4	0	−10	8	20	51
•2N4857	TO-18	40	1	0.25	20	0.25	15	−10	2	6	15	.5	20	100	15	40		18	0	−10	8	0	−10	10	50	51
2N4857A	TO-18	40	1	0.25	20	0.25	15	−10	2	6	15	.5	20	100	15	40		10	0	−10	3.5	0	−10	10	40	51
•2N4858	TO-18	40	1	0.25	20	0.25	15	−10	0.8	4	15	.5	8	80	15	60		18	0	−10	8	0	−10	20	100	51
2N4858A	TO-18	40	1	0.25	20	0.25	15	−10	0.8	4	15	.5	8	80	15	60		10	0	−10	3.5	0	−10	16	80	51
•2N4859	TO-18	30	1	0.25	15	0.25	15	−10	4	10	15	.5	50		15	25		18	0	−10	8	0	−10	9	25	51
2N4859A	TO-18	30	1	0.25	15	0.25	15	−10	4	10	15	.5	50		15	25		10	0	−10	4	0	−10	8	20	51
•2N4860	TO-18	30	1	0.25	15	0.25	15	−10	2	6	15	.5	20	100	15	40		18	0	−10	8	0	−10	10	50	51
2N4860A	TO-18	30	1	0.25	15	0.25	15	−10	2	6	15	.5	20	100	15	40		10	0	−10	3.5	0	−10	10	40	51
•2N4861	TO-18	30	1	0.25	15	0.25	15	−10	0.8	4	15	.5	8	80	15	60		18	0	−10	8	0	−10	20	100	51
2N4861A	TO-18	30	1	0.25	15	0.25	15	−10	0.8	4	15	.5	8	80	15	60		10	0	−10	3.5	0	−10	16	80	51
2N5432	TO-52	25	1	0.2	15	0.2	5	−10	4	10	5	3	150		15	5	10	30	0	−10	15	0	−10	5	36	58
2N5433	TO-52	25	1	0.2	15	0.2	5	−10	3	9	5	3	100		15	7	10	30	0	−10	15	0	−10	5	36	58
2N5434	TO-52	25	1	0.2	15	0.2	5	−10	1	4	5	3	30		15	10	10	30	0	−10	15	0	−10	5	36	58
2N5555	TO-92	25	10	1	15	10	12	−10		(10)			15		15	150		5	15	0	1.2	0	−10	10	25	50

•**Note:** MIL JAN, TX JAN parts in process of qualification. Consult factory representative for delivery status.

N-Channel FETs

SWITCHES/CHOPPERS (Cont.)

Type No.	Case Style	BV_{GSS} *BV_{GDO} (V) Min	@ I_G (μA)	I_{GSS} *I_{DGO} (nA) Max	@ V_{DG} (V)	$I_{D(off)}$ (nA) Max	@ V_{DG} (V)	V_{GS} (V)	V_p (V) Min	Max	@ V_{DS} (V)	I_D (nA)	I_{DSS} (mA) Min	Max	@ V_{DS} (V)	$r_{ds(on)}$ (Ω) Max	@ I_D (mA)	C_{iss} (pF) Max	@ V_{DS} (V)	V_{GS} (V)	C_{rss} (pF) Max	@ V_{DS} (V)	V_{GS} (V)	t_{on} (ns) Max	t_{off} (ns) Max	Process No.
2N5638	TO-92	30	10	1	15	1	15	−12		(12)			50		20	30	1	10	0	−12	4	0	−12			51
2N5639	TO-92	30	10	1	15	1	15	−8		(8)			25		20	60	1	10	0	−12	4	0	−8			51
2N5640	TO-92	30	10	1	15	1	15	−6		(6)			5		20	100	1	10	0	−12	4	0	−6			51
2N5653	TO-92	30	10	1	15	1	15	−12		(12)			40		20	50	1	10	0	−12	3.5	0	−12	9	15	51
2N5654	TO-92	25	10	1	15	10	15	−8		(8)			15		20	100	1	10	0	−12	3.5	0	−8	14	30	51
E109	TO-106	25	1	3	15	3	5	−10	2	6	5	1μ	40		15	12		85	0	0	15	0	−10			58
ITE4391	TO-106	40	1	1	20	1	20	−12	4	10	20	1	50	150	20	30		14	20	0	35	0	−12	20	35	51
ITE4392	TO-106	40	1	1	20	1	20	−12	4	10	20	1	50	150	20	30		14	20	0	35	0	−12	20	35	51
ITE4393	TO-106	40	1	1	20	1	20	−12	4	10	20	1	50	150	20	30		14	20	0	35	0	−12	20	35	51
KE4091	TO-106	40	1	1*	20	1	20	−12	5	10	20	1	30		20	30		16	20	0	5	20	0	25	40	51
KE4092	TO-106	40	1	1*	20	1	20	−8	2	7	20	1	15		20	50		16	20	0	5	20	0	35	60	51
KE4093	TO-106	40	1	1*	20	1	20	−6	1	5	20	1	8		20	80		16	20	0	5	20	0	60	80	51
KE4391	TO-106	40	1	1	20	1	20	−12	4	10	20	1	50	150	20	30		14	20	0	3.5	0	−12	20	35	51
KE4392	TO-106	40	1	1	20	1	20	−7	2	5	20	1	25	75	20	60		14	20	0	3.5	0	−7	40	80	51
KE4393	TO-106	40	1	1	20	1	20	−5	0.5	3	20	1	5	30	20	100		14	20	0	3.5	0	−5	55	130	51
KE4856	TO-106	40	1	1	20	1	15	−10	4	10	15	.5	50		15	25		18	0	−10	8	0	−10	9	25	51
KE4857	TO-106	40	1	1	20	1	15	−10	2	6	15	.5	20	100	15	40		18	0	−10	8	0	−10	10	50	51
KE4858	TO-106	40	1	1	20	1	15	−10	0.8	4	15	.5	8	80	15	60		18	0	−10	8	0	−10	20	100	51
KE4859	TO-106	30	1	1	15	1	15	−10	4	10	15	.5	50		15	25		18	0	−10	8	0	−10	9	25	51
KE4860	TO-106	30	1	1	15	1	15	−10	2	6	15	.5	20	100	15	40		18	0	−10	8	0	−10	10	50	51
KE4861	TO-106	30	1	1	15	1	15	−10	0.8	4	15	.5	8	80	15	60		18	0	−10	8	0	−10	20	100	51
KE510	TO-106	30	1	10	15				0.5	10	20	10	5		10	100		18	0	−10	6	0	−10			51
KE511	TO-106	20	1	100	10					10	10	100	5		10	‡100		18	0	−10	8	0	−10			51
NF510	TO-18	30	1	10	15				0.5	10	20	10	5		10	100		18	0	−10	6	0	−10			51
NF511	TO-18	20	1	100	10					10	10	100	5		10	‡100		18	0	−10	8	0	−10			51
NF580	TO-52	25	1	1	15	1	5	−12	4	12	5	3				5	10	25	0	−15	13	0	−15	5	25	58
NF581	TO-52	25	1	1	15	1	5	−10	4	10	5	3				6	10	25	0	−15	13	0	−15	5	25	58
NF582	TO-52	25	1	1	15	1	5	−10	2	6	5	3				10	10	25	0	−15	13	0	−15	5	25	58
NF583	TO-52	25	1	1	15	1	5	−10	0.5	4	5	3				20	10	25	0	−15	13	0	−15	10	25	58
NF584	TO-52	15	1	50	15	50	5	−10		10	5	50				10	10	25	0	−15	13	0	−15			58
NF585	TO-52	15	1	50	15	50	5	−10		6	5	50				20	10	25	0	−15	13	0	−15			58
NF4445	TO-52	25	1	3*	15	3	5	−10	2	10	5	3	150		2	5	10	50	0	−10	25	0	−10			58
NF4446	TO-52	25	1	3*	15	3	5	−10	2	10	5	3	100		2	10	10	50	0	−10	25	0	−10			58
NF4447	TO-52	20	1	3*	15	3	5	−10	2	10	5	3	150		2	6	10	50	0	−10	25	0	−10			58
NF4448	TO-52	20	1	3*	15	3	5	−10	2	10	5	3	100		2	12	10	50	0	−10	25	0	−10			58
TIS73	TO-106	30	1	2	15	2	15	−10	4	10	15	4	50		15	25		18	0	−10	8	0	−10	9	25	51
TIS74	TO-106	30	1	2	15	2	15	−10	2	6	15	4	20	100	15	40		18	0	−10	8	0	−10	10	50	51
TIS75	TO-106	30	1	2	15	2	15	−10	0.8	4	15	4	8	80	15	60		18	0	−10	8	0	−10	20	100	51

U1897E	TO-106	40	1	0.2*	20			5	10	20	1	30		20	30	1	16	20	0	5	0	−20	25	40	51
U1898E	TO-106	40	1	0.2*	20			2	7	20	1	15		20	50	1	16	20	0	5	0	−20	35	60	51
U1899E	TO-106	40	1	0.2*	20			1	5	20	1	8		20	80	1	16	20	0	5	0	−20	60	80	51
UC250	TO-18	30	1	1	20			5	10	20	1	50	150	20	30		25	20	0	7	10	0			51
UC251	TO-18	30	1	1	20			1	6	20	1	7.5	75	20	75		25	20	0	7	10	0			51

•**Note:** MIL JAN, TX JAN parts in process of qualification. Consult factory representative for delivery status.

RF AMPS AND/OR VHF, UHF AMPS

N-Channel FETs

Type No.	Case Style	BV_{GSS} *BV_{GDO} (V) Min	@ I_G (μA)	I_{GSS} *I_{DGO} (nA) Max	@ V_{DG} (V)	V_p (V) Min	Max	@ V_{DS} (V)	I_D (nA)	I_{DSS} (mA) Min	Max	@ V_{DS} (V)	$\lvert Re(Y_{fs})\rvert$ (mmho) Min	@ Freq (MHz)	$Re(Y_{os})$ (μmho) Max	@ f (MHz)	C_{iss} (pF) Max	@ V_{DS} (V)	V_{GS} (V)	C_{rss} (pF) Max	@ V_{DS} (V)	V_{GS} (V)	NF (dB) @ R_G = 1k Max	Freq (MHz)	Process No.
2N3819	TO-92	25	1	2	15		8	15	2	2	20	15	1.6	100			8	15	0	4	15	0			50
•2N3823	TO-72	30	1	0.5	20		8	15	.5	4	20	15	3.2	200	200	200	6	15	0	2	15	0	2.5	100	50
2N4223	TO-72	30	10	0.25	20	0.1	8	15	.25	3	18	15	2.7	200	200	200	6	15	0	2	15	0	5	200	50
2N4224	TO-72	30	10	0.5	20	0.1	8	15	.5	2	20	15	1.7	200	200	200	6	15	0	2	15	0			50
2N4416	TO-72	30	1	0.1	20		6	15	1	5	15	15	4	400	100	400	4	15	0	0.8	15	0	4	400	50
•2N4416A	TO-72	30	1	0.1	20	2.5	6	15	1	5	15	15	4	400	100	400	4	15	0	0.8	15	0	4	400	50
2N5078	TO-72	30	1	0.25	20	0.5	8	15		4	25	15	4	200	150	200	6	15	0	2	15	0	3	200	50
2N5245	TO-106	30	1	1	20	1	6	15	10	5	15	15	4	400	100	400	4.5	15	0	1	15	0	4	400	50
2N5246	TO-106	30	1	1	20	0.5	4	15	10	1.5	7	15	2.5	400	100	400	4.5	15	0	1	15	0			50
2N5247	TO-106	30	1	1	20	1.5	8	15	10	8	24	15	4	400	150	400	4.5	15	0	1	15	0			50
2N5248	TO-92	30	1	5	20	1	8	15	10	4	20	15	3	200	200	200	6	15	0	2	15	0			50
2N5397	TO-72	25	1	0.1	15	1	6	10	1	10	30	10	5.5	450	200	450	5	10	10m	1.2	10	10m	3.5	450	90
2N5398	TO-72	25	1	0.1	15	1	6	10	1	5	40	10	5.0	450	400	450	5.5	10	0	1.3	10	0	3.2	450	90
2N5484	TO-92	25	1	0.1	20	0.3	3	15	10	1	5	15	2.5	100	75	100	5	15	0	1	15	0	3	100	50
2N5485	TO-92	25	1	1	20	1	4	15	10	4	10	15	3	400	100	400	5	15	0	1	15	0	4	400	50
2N5486	TO-92	25	1	1	20	2	6	15	10	8	20	15	3.5	400	100	400	5	15	0	1	15	0	4	400	50
2N5668	TO-92	25	10	2	15	0.2	4	15	10	1	5	15	1	100	50	100	7	15	0	3	15	0	2.5	100	50
2N5669	TO-92	25	10	2	15	1	6	15	10	4	8	15	1.6	100	100	100	7	15	0	3	15	0	2.5	100	50
2N5670	TO-92	25	10	2	15	2	8	15	10	8	20	15	2.5	100	150	100	7	15	0	3	15	0	2.5	100	50
BF256A	TO-92	30	1	5	20	0.5	7.5	15	100	3	7	15	4	400	100	400	4.5	15	0	1	15	0	4	400	50
BF256B	TO-92	30	1	5	20	0.5	7.5	15	100	6	13	15	4	400	100	400	4.5	15	0	1	15	0	4	400	50
BF256C	TO-92	30	1	5	20	0.5	7.5	15	100	11	18	15	4	400	100	400	4.5	15	0	1	15	0	4	400	50
E300	TO-106	25	1	0.5	15	1	6	10	1	6	30	10	4.5	0.001	200	0.001	5.5	10	5m	1.7	10	5m	t2	100	90
E308	TO-106	25	1	1	15	1	6.5	10	1	12	60	10	8.0	0.001	200	0.001	5	0	−10	2.5	0	−10	1.5	100	92
E309	TO-106	25	1	1	15	1	4	10	1	12	30	10	10	0.001	150	0.001	5	0	−10	2.5	0	−10	1.5	100	92
E310	TO-106	25	1	1	15	2	6.5	10	1	24	60	10	8.0	0.001	200	0.001	5	0	−10	2.5	0	−10	1.5	100	92
E311	TO-106	25	1	1	15	1	4	10	1	12	30	10	10	0.001	150	0.001	5	10	10m	2.5	10	10m	1.5	100	92
E312	TO-106	25	1	1	15	2	6.5	10	1	24	60	10	8.0	0.001	200	0.001	5	10	10m	2.5	10	10m	1.5	100	92

•**Note:** MIL JAN, TX JAN parts in process of qualification. Consult factory representative for delivery status.

RF AMPS AND/OR VHF, UHF AMPS (Cont.)

N-Channel FETs

Type No.	Case Style	BV_{GSS} *BV_{GDO} (V) Min	@ I_G (μA)	I_{GSS} *I_{DGO} (nA) Max	@ V_{DG} (V)	V_P (V) Min	Max	@ V_{DS} (V)	I_D (nA)	I_{DSS} (mA) Min	Max	@ V_{DS} (V)	$\lvert Re\ Y_{fs}\rvert$ * (mmho) @ Freq Min	(MHz)	$Re(Y_{os})$ (μmho) @ f Max	(MHz)	C_{iss} (pF) Max	@ V_{DS} (V)	V_{GS} (V)	C_{rss} (pF) Max	@ V_{DS} (V)	V_{GS} (V)	NF (dB) @ R_G = 1k Max	Freq (MHz)	Process No.
KE4223	TO-106	30	1	0.25	20	0.1	8	15	1	3	18	15	2.7	200	200	200	6	15	0	2	15	0	5	200	50
KE4224	TO-106	30	1	0.25	20	0.1	8	15	5	2	20	15	1.7	200	200	200	6	15	0	2	15	0			50
KE4416	TO-106	30	1	0.1	20		6	15	1	5	15	15	4	400	100	400	4	15	0	0.8	15	0	4	400	50
MPF102	TO-92	25	1	2	15		8	15	2	2	20	15	1.6	100	100	200	7	15	0	3	15	0			50
MPF106	TO-92	25	1	1	20	0.5	4	15	.5	4	10	15	2.5	0.001			5	15	0	2	15	0	4	400	50
MPF107	TO-92	25	1	1	20	2	6	15	.5	8	20	15	4	0.001			5	15	0	1.2	15	0	4	400	50
MPF108	TO-92	25	10	1	15	0.5	8	15	10μ	1.5	24	15	1.6	100	200	100	6.5	15	0	2.5	15	0	3	100	50
TIS34	TO-106	30	1	5	20	1	8	15	10	4	20	15	3	200	200	200	6	15	0	2	15	0			50
TIS88	TO-106	30	1	1	20	1	6	15	10	5	15	15	4	400	100	400	4.5	15	0	1	15	0	4	400	50
U308	TO-52	25	1	0.15	15	1	6	10	1	12	60	10	10	0.001	180	100	5	0	-10	2.5	0	10	t3	450	92
U309	TO-52	25	1	0.15	15	1	4	10	1	12	30	10	10	0.001	180	100	5	0	-10	2.5	0	10	t3	450	92
U310	TO-52	25	1	0.15	15	2.5	6	10	1	24	60	10	10	0.001	180	100	5	0	10	2.5	10	10mA	t3	450	92
U312	TO-52	25	1	0.1	15	1	6	10	1	10	30	10	6	0.001			3.8	10	10m	1.2	10	10mA	t3	450	90
U1994E	TO-106	30	1	0.1	20		6	15	1	5	15	15	4	400	100	400	4	15	0	0.8	15	0	4	400	50
UC734	TO-72	30	1	5	20	1	8	15	10	4	20	15	3	200	200	200	4	15	0	0.8	15	0			50
UC734E	TO-106	30	1	5	20	1	8	15	10	4	20	15	3	200	200	200	4.5	15	0	1	15	0			50

•Note: MIL JAN, TX JAN parts in process of qualification. Consult factory representative for delivery status.

LOW FREQUENCY — LOW NOISE AMPLIFIERS

N-Channel FETs

Type No.	Case Style	g_{fs} ($\lvert Re Y_{fs}\rvert$) (mmho) Min	Max	V_{DS} (V)	f (MHz)	I_{DSS} (mA) Min	Max	@ V_{DS} (V)	$V_{GS(OFF)}$ (V) Min	Max	@ V_{DS} (V)	I_D (nA)	BV_{GSS} (V) @ I_G Min	(μA)	I_{GSS} (nA) @ V_{DG} Max	(V)	G_{oss} (μmho) Max	V_{DS} (V)	C_{iss} (pF) @ V_{DS} Max	(V)	$-V_{GS}$ (V)	C_{rss} (pF) @ V_{DS} Max	(V)	$\bar{e}_n$ $nV/\sqrt{Hz}$ @ f Max	(Hz)	Process No.
2N4393	TO-18	t12		20	0.001	5.0	30	20	0.5	3.0	20	1.0	40	1.0	0.1	20			14	20	0	3.5	5.0(GS)	t8.0	10	51
2N4867A	TO-72	0.7	2.0	20	0.001	0.4	1.2	20	0.7	2.0	20	1.0k	40	1.0	0.25	30	1.5	20	25	20	0	5.0	20	10	10	57
2N4868A	TO-72	1.0	3.0	20	0.001	1.0	3.0	20	1.0	3.0	20	1.0k	40	1.0	0.25	30	4.0	20	25	20	0	5.0	20	10	10	57
2N4869A	TO-72	1.3	4.0	20	0.001	2.5	7.5	20	1.8	5.0	20	1.0k	40	1.0	0.25	30	10	20	25	20	0	5.0	20	10	10	57
2N4867	TO-72	0.7	2.0	20	0.001	0.4	1.2	20	0.7	2.0	20	1.0k	40	1.0	0.25	30	1.5	20	25	20	0	5.0	20	20	10	57
2N4868	TO-72	1.0	3.0	20	0.001	1.0	3.0	20	1.0	3.0	20	1.0k	40	1.0	0.25	30	4.0	20	25	20	0	5.0	20	20	10	57
2N4869	TO-72	1.3	4.0	20	0.001	2.5	7.5	20	1.8	5.0	20	1.0k	40	1.0	0.25	30	10	20	25	20	0	5.0	20	20	10	57
2N5556	TO-72	1.5	6.5	15	0.001	0.5	2.5	15	0.2	4.0	15	1.0	30	10	0.1	15	20	15	6.0	15	0	3.0	15	35	10	50
2N5557	TO-72	1.5	6.5	15	0.001	2.0	5.0	15	0.8	5.0	15	1.0	30	10	0.1	15	20	15	6.0	15	0	3.0	15	35	10	50
2N5558	TO-72	1.5	6.5	15	0.001	4.0	10	15	1.5	6.0	15	1.0	30	10	0.1	15	20	15	6.0	15	0	3.0	15	35	10	50
KE4393	TO-106	t12		20	0.001	5.0	30	20	0.5	3.0	20	1.0	40	1.0	0.1	20			14	20	0	3.5	5.0(GS)	t8.0	10	51
UC241	TO-72	2.0		20	0.001	1.0	10	20		5.0	20	1.0	50	1.0	0.25	20			20	20	0	5.0	20	20	10	57

N-Channel FETs

ULTRA-LOW INPUT CURRENT AMPS

Transistor Type	Case Style	BV_{GSS} *BV_{GDO} (V) Min	@ I_G (μA)	I_{GSS} *I_{DGO} (pA) Max	@ V_{DG} (V)	V_p (V) Min	Max	@ V_{DS} (V)	I_D (nA)	I_{DSS} (μA) Min	Max	@ V_{DS} (V)	G_{fs} (μmho) Min	Max	@ V_{DS} (V)	G_{oss} (μmho) Max	@ V_{DS} (V)	C_{iss} (pF) Max	@ V_{DS} (V)	V_{GS} (V)	C_{rss} (pF) Max	@ V_{DS} (V)	V_{GS} (V)	$\bar{e}_n$ $\left(\frac{NV}{\sqrt{Hz}}\right)$ Max	@ f (Hz)	Process No.
2N4117	TO-72	40	1	10	20	0.6	1.8	10	1	30	90	10	20	210	10	3	10	3	10	0	1.5	10	0			53
2N4117A	TO-72	40	1	1	20	0.6	1.8	10	1	30	90	10	70	210	10	3	10	3	10	0	1.5	10	0			53
2N4118	TO-72	40	1	10	20	1	3	10	1	80	240	10	80	250	10	5	10	3	10	0	1.5	10	0			53
2N4118A	TO-72	40	1	1	20	1	3	10	1	80	240	10	80	250	10	5	10	3	10	0	1.5	10	0			53
2N4119	TO-72	40	1	10	20	2	6	10	1	200	600	10	100	330	10	10	10	3	10	0	1.5	10	0			53
2N4119A	TO-72	40	1	1	20	2	6	10	1	200	600	10	100	330	10	10	10	3	10	0	1.5	10	0			53

N-Channel FETs

GENERAL PURPOSE AMPS

Transistor Type	Case Style	BV_{GSS} *BV_{GDO} (V) Min	@ I_G (μA)	I_{GSS} *I_{DGO} (nA) Max	@ V_{DG} (V)	V_p (V) Min	Max	@ V_{DS} (V)	I_D (nA)	I_{DSS} (mA) Min	Max	@ VDS (V)	G_{fs} (mmho) Min	Max	@ V_{DS} (V)	G_{oss} (μmho) Max	@ V_{DS} (V)	C_{iss} (pF) Max	@ V_{DS} (V)	V_{GS} (V)	C_{rss} (pF) Max	@ V_{DS} (V)	V_{GS} (V)	$\bar{e}_n$ $\left(\frac{NV}{\sqrt{Hz}}\right)$ Max	@ Freq (Hz)	Process No.
2N3069	TO-18	*50	1	1	30		9.5	30	1000	2	10	30	1	2.5	30	80	30	15	0	−12	1.5	30	0	125	1000	52
2N3070	TO-18	*50	1	1	30		4.5	30	1000	0.5	2.5	30	0.75	2.5	30	30	30	15	0	−8	1.5	30	0	125	1000	52
2N3071	TO-18	*50	1	1	30		2.2	30	1000	0.5	2.5	30	0.75	2.5	30	30	30	15	0	−8	1.5	30	0	125	1000	52
2N3089	TO-18	15	1	1	10	1	5	15	100	0.5	2	10	0.3	2	15	50	15	6	15	0	2	15	0	125	avg 10-15k	52
2N3089A	TO-18	15	1	1	10	1	5	15	100	0.5	2	10	0.3	2	15	50	15	6	15	0	2	15	0	45	avg 10-15k	52
2N3365	TO-18	*40	1	5	30		11.5	20	1000	0.8	4	30	0.4	2	30	50	30	15	8	0	2.5	30	0			52
2N3367	TO-18	*40	1	5	30		2.2	20	1000	0.05	0.25	30	0.1	1	30	10	30	15	8	0	2.5	30	0			53
2N3368	TO-18	*40	1	5	30		11.5	20	1000	2	12	30	1	4	30	80	30	20	8	0	3	30	0			52
2N3369	TO-18	*40	1	5	30		6.5	20	1000	0.5	2.5	30	0.6	2.5	30	30	30	20	8	0	3	30	0			52
2N3370	TO-18	*40	1	5	30		3.2	20	1000	0.1	0.6	30	0.3	2.5	30	15	30	20	8	0	3	30	0			52
2N3436	TO-18	*50	1	0.5	30		9.8	20	1000	3	15	20	2.5	10	20	35	30	18	0	−10	6	30	0	100	1000	55
2N3437	TO-18	*50	1	0.5	30		4.8	20	1000	0.8	4	20	1.5	6	20	20	30	18	0	−6	6	30	0	100	1000	55
2N3438	TO-18	*50	1	0.5	30		2.3	20	1000	0.2	1	20	0.8	4.5	20	5	30	18	0	−4	6	30	0	100	1000	55
2N3452	TO-72	*50	1	0.1	30		9.8	20	1000	0.8	4	30	0.2	1.2	30	15	30	6	0	−12	1.5	30	0	100	100	53
2N3453	TO-72	*50	1	0.1	30		4.8	20	1000	0.2	1	30	0.15	0.9	30	5	30	6	0	−8	1.5	30	0	100	100	53
2N3454	TO-72	*50	1	0.1	30		2.3	20	1000	0.05	0.25	30	0.1	0.6	30	3	30	6	0	−4	1.5	30	0	100	100	53
2N3455	TO-72	*50	1	0.4	30		9.8	20	1000	0.8	4	30	0.3	9	30	5	30	5	0	−12	1.5	30	0	155	20	53
2N3456	TO-72	*50	1	0.4	30		4.8	20	1000	0.2	1	30	0.15	0.6	30	3	30	5	0	−8	1.5	30	0	155	20	53
2N3457	TO-72	*50	1	0.4	30		2.3	20	1000	0.05	0.25	30	0.15	0.6	30	3	30	5	0	−4	1.5	30	0	155	20	53

•NOTE: MIL JAN, TXJAN parts in process of qualification. Consult factory representative for delivery status.

♦I_D = 1.0 mA †I_D = 500μA ¶ I_D = 250μA § I_D = 200μA **I_D = 100μA ††I_D = 40μA

GENERAL PURPOSE AMPS (Cont.)

N-Channel FETs

Transistor Type	Case Style	BV_{GSS} *BV_{GDO} (V) Min	@ I_G (μA)	I_{GSS} *I_{DGO} (nA) Max	@ V_{DG} (V)	V_p (V) Min	Max	@ V_{DS} (V)	I_D (nA)	I_{DSS} (mA) Min	Max	@ VDS (V)	G_{fs} (mmho) Min	Max	@ V_{DS} (V)	G_{oss} (μmho) Max	@ V_{DS} (V)	C_{iss} (pF) @ Max	V_{DS} (V)	V_{GS} (V)	C_{rss} (pF) @ Max	V_{DS} (V)	V_{GS} (V)	$\bar{e}_n$ $\left(\frac{NV}{\sqrt{Hz}}\right)$ Max	@ Freq (Hz)	Process No.
2N3458	TO-18	*50	1	0.25	30		7.8	20	1000	3	15	20	2.5	10	20	35	30	18	0	−10	5	30	0	225	20	55
2N3459	TO-18	*50	1	0.25	30		3.4	20	1000	0.8	4	20	1.5	6	20	20	30	18	0	−6	5	30	0	155	20	55
2N3460	TO-18	*50	1	0.25	30		1.8	20	1000	0.2	1	20	0.8	4.5	20	5	30	18	0	−4	5	30	0	155	20	52
2N3684	TO-72	50	1	0.1	30	2	5	20	1	2.5	7.5	20	2	3	20	50	20	4	20	0	1.2	20	0	150	100	52
2N3685	TO-72	50	1	0.1	30	1	3.5	20	1	1	3	20	1.5	2.5	20	25	20	4	20	0	1.2	20	0	150	100	52
2N3686	TO-72	50	1	0.1	30	0.6	2	20	1	0.4	1.2	20	1	2	20	10	20	4	20	0	1.2	20	0	150	100	52
2N3687	TO-72	50	1	0.1	30	0.3	1.2	20	1	0.1	0.5	20	0.5	1.5	20	5	20	4	20	0	1.2	20	0	150	100	52
•2N3821	TO-72	50	1	0.1	30		4	15	.5	0.5	2.5	15	1.5	4.5	15	10	15	6	15	0	3	15	0	200	10	55
•2N3822	TO-72	50	1	0.1	30		6	15	.5	2	10	15	3	6.5	15	20	15	6	15	0	3	15	0	200	10	55
2N3967	TO-72	30	1	0.1	20	2	5	20	1	2.5	10	20	2.5		20	35	20¶	5	20	¶	1.3	20	♠	84	100	50
2N3967A	TO-72	30	1	0.1	20	2	5	20	1	2.5	10	20	2.5		20	35	20¶	5	20	¶	1.3	20	♠	160	10	50
2N3968	TO-72	30	1	0.1	20		3	20	1	1	5	20	2		20	15	20**	5	20	**	1.3	20	†	84	100	50
2N3968A	TO-72	30	1	0.1	20		3	20	1	1	5	20	2		20	15	20**	5	20	**	1.3	20	†	160	10	50
2N3969	TO-72	30	1	0.1	20		1.7	20	1	0.4	2	20	1.3		20	5	20††	5	20	††	1.3	20	¶	84	100	50
2N3969A	TO-72	30	1	0.1	20		1.7	20	1	0.4	2	20	1.3		20	5	20††	5	20	††	1.3	20	¶	160	10	50
2N4139	TO-18	50	1	1	30	2	8	20	1	8	11	20	3.5	7	20	35	20	18	20	0	5	20	0	100	1000	55
2N4220	TO-72	30	10	0.1	15		4	15	.1	0.5	3	15	1	4	15	10	15	6	15	0	2	15	0			52
2N4220A	TO-72	30	10	0.1	15		4	15	.1	0.5	3	15	1	4	15	10	15	6	15	0	2	15	0	115	100	52
2N4221	TO-72	30	10	0.1	15		6	15	.1	2	6	15	2	5	15	20	15	6	15	0	2	15	0			55
2N4221A	TO-72	30	10	0.1	15		6	15	.1	2	6	15	2	5	15	20	15	6	15	0	2	15	0	115	100	55
2N4222	TO-72	30	10	0.1	15		8	15	.1	5	15	15	2.5	6	15	40	15	6	15	0	2	15	0			55
2N4222A	TO-72	30	10	0.1	15		8	15	.1	5	15	15	2.5	6	15	40	15	6	15	0	2	15	0	115	100	55
2N4302	TO-106	30	1	1	10		4	20	10	0.5	5	20	1		20	50	20	6	20	0	3	20	0	100	1000	50
2N4303	TO-106	30	1	1	10		6	20	10	4	10	20	2		20	50	20	6	20	0	3	20	0	100	1000	50
2N4304	TO-106	30	1	1	10		10	20	10	0.5	15	20	1		20	50	20	6	20	0	3	20	0	125	1000	50
2N4338	TO-18	50	1	0.1	30	0.3	1	15	100	0.2	0.6	15	0.6	1.8	15	5	15	7	15	0	3	15	0	68	1000	52
2N4339	TO-18	50	1	0.1	30	0.6	1.8	15	100	0.5	1.5	15	0.8	2.4	15	15	15	7	15	0	3	15	0	68	1000	52
2N4340	TO-18	50	1	0.1	30	1	3	15	100	1.2	3.6	15	1.3	3	15	30	15	7	15	0	3	15	0	68	1000	52
2N4341	TO-18	50	1	0.1	30	2	6	15	100	3	9	15	2	4	15	60	15	7	15	0	3	15	0	68	1000	52
2N5103	TO-72	25	10	0.1	15	0.5	4	15	1	1	8	15	2	8	15	100	15	5	15	0	1	15	0	100	10	50
2N5104	TO-72	25	1	0.1	15	0.5	4	15	1	2	6	15	3.5	7.5	15	100	15	5	15	0	1	15	0	50	10	50
2N5163	TO-106	25	1	10	15	0.4	8	15	1000	1	40	15	2	9	15	200	15	12	15	0	3	15	0	50	1000	50
2N5358	TO-72	40	1	0.1	20	0.5	3	15	100	0.5	1	15	1	3	15	10	15	6	15	0	2	15	0	115	100	52
2N5359	TO-72	40	1	0.1	20	0.8	4	15	100	0.6	1.6	15	1.2	3.6	15	10	15	6	15	0	2	15	0	115	100	52
2N5360	TO-72	40	1	0.1	20	0.8	4	15	100	0.5	2.5	15	1.4	4.2	15	20	15	6	15	0	2	15	0	115	100	52
2N5361	TO-72	40	1	0.1	20	1	6	15	100	2.5	5	15	1.5	4.5	15	20	15	6	15	0	2	15	0	115	100	55
2N5362	TO-72	40	1	0.1	20	2	7	15	100	4	8	15	2	5.5	15	40	15	6	15	0	2	15	0	115	100	55
2N5363	TO-72	40	1	0.1	20	2.5	8	15	100	7	14	15	2.5	6	15	40	15	6	15	0	2	15	0	115	100	55
2N5364	TO-72	40	1	0.1	20	2.5	8	15	100	9	18	15	2.7	6.5	15	60	15	6	15	0	2	15	0	115	100	55
2N5457	TO-92	25	1	1	15	0.5	6	15	10	1	5	15	2	5	15	50	15	7	15	0	3	15	0			55

2N5458	TO-92	25	1	1	15	1	7	15	10	2	9	15	1.5	5.5	15	50	15	7	15	0	3	15	0			55
2N5459	TO-92	25	1	1	15	2	8	15	10	4	16	15	2	6	15	50	15	7	15	0	3	15	0			55
2N5556	TO-72	30	1	0.1	15	0.2	4	15	1	0.5	2.5	15	1.5	6.5	15	20	15	6	15	0	3	15	0	35	10	50
2N5557	TO-72	30	1	0.1	15	0.2	4	15	1	0.5	2.5	15	1.5	6.5	15	20	15	6	15	0	3	15	0	35	10	50
2N5558	TO-72	30	1	0.1	15	0.8	5	15	1	2	5	15	1.5	6.5	15	20	15	6	15	0	3	15	0	35	10	50
2N5716	TO-92	40	10	1	20	0.2	3	15	1	0.05	0.25	15	0.2	1	15	25	15	5	15	0	1.5	15	0			52
2N5717	TO-92	40	10	1	20	0.5	5	15	1	0.2	1	15	0.4	1.6	15	25	15	5	15	0	1.5	15	0			52
2N5718	TO-92	40	10	1	20	1	8	15	1	0.8	4	15	0.5	2	15	25	15	5	15	0	1.5	15	0			52
E100	TO-106	30	1	0.5	20	0.3	10	20	10	0.2	20	20	0.5		20			8	20	0	3	20	0			52
E101	TO-106	30	1	0.5	20	0.3	1.5	20	10	0.2	1	20	0.5		20			8	20	0	3	20	0			52
E102	TO-106	30	1	0.5	20	0.8	4	20	10	0.9	4.5	20	1		20			8	20	0	3	20	0			52
E103	TO-106	30	1	0.5	20	2	10	20	10	4	20	20	1.5		20			8	20	0	3	20	0			52
KE3684	TO-106	50	1	1	30	2	5	20	1	2.5	7.5	20	2	3	20	50	20	4	20	0	1.2	20	0	150	20	52
KE3685	TO-106	50	1	1	30	1	3.5	20	1	1	3	20	1.5	2.5	20	25	20	4	20	0	1.2	20	0	150	20	52
KE3686	TO-106	50	1	1	30	0.6	2	20	1	0.4	1.2	20	1	2	20	10	20	4	20	0	1.2	20	0	150	20	52
KE3687	TO-106	50	1	1	30	0.3	1.2	20	1	0.1	0.5	20	0.5	1.5	20	5	20	4	20	0	1.2	20	0	150	20	52
KE4220	TO-106	30	10	1	15		4	15	1	0.5	3	15	1	4	15	10	15	6	15	0	2	15	0			55
KE4221	TO-106	30	10	1	15		6	15	1	2	6	15	2	5	15	20	15	6	15	0	2	15	0			55
KE4222	TO-106	30	10	1	15		8	15	1	5	15	15	2.5	6	15	40	15	6	15	0	2	15	0			55
MPF103	TO-92	25	1	1	15		6	15	1	1	5	15	1	5	15	50	15	7	15	0	3	15	0			55
MPF104	TO-92	25	1	1	15		7	15	1	2	9	15	1.5	5.5	15	50	15	7	15	0	3	15	0			55
MPF105	TO-92	25	1	1	15		8	15	1	4	16	15	2	6	15	50	15	7	15	0	3	15	0			55
MPF109	TO-92	25	10	1	15	0.2	8	15	10	0.5	24	15	0.8	6	15	75	15	7	15	0	3	15	0	115	1000	55
MPF110	TO-92	20	10	100	10	0.5	10	10	1000	0.5	20	10	0.5	7.5	10											50
MPF111	TO-92	20	10	100	10	0.5	10	10	1000	0.5	20	10	0.5	0.5	10	200	10									50
MPF112	TO-92	25	10	100	10	0.5	10	10	1000	1	25	10	1	7.5	10											55
TIS58	TO-92	25	1	4	15	0.5	5	15	20	2.5	8	15	1.3	4	15			6	15	2 mA	3	15	2 mA			50
UC714	TO-18	30	1	1	20		8	20	1	2	20	20	2	6.5	20			8	20	0	4	20	0	100	100	52

•**Note:** MIL JAN, TXJAN parts in process of qualification. Consult factory representative for delivery status.

♦I_D = 1 mA †I_D = 500μA ¶I_D = 250μA §I_D = 200μA **I_D = 100μA ††I_D = 40μA

N-Channel FETs

GENERAL PURPOSE DUAL JFETS

Type No.	Case Style	OPERATING CONDITIONS FOR THESE CHARACTERISTICS: OP. CHAR. V_{DG} (V)	OP. CHAR. I_D (μA)	$\lvert V_{GS1-2}\rvert$ V_{OS} (mV) Max	DRIFT (μV/°C) ΔV_{GS} Max	I_G (pA) Max	G_{fs} μmhos Min	G_{fs} μmhos Max	G_{oss} (μmho) Max	CMRR (dB) Min	V_{gs} (V) Min	V_{gs} (V) Max	$\bar{e}_n$ (nV/√Hz) @ f Max	f (Hz)	C_{iss} (pF) Max	C_{rss} (pF) Max	BV (V) Min	I_{DSS} (mA) Min	I_{DSS} (mA) Max	V_p (V) Min	V_p (V) Max	G_{fs} (μmho) Min	G_{fs} (μmho) Max	G_{oss} (μmho) Max	I_{GSS} (pA) Max @ V_{DG} (V)	I_{DSS} Match %	G_{fs} Match %	G_{oss1-2} (μmho)	I_{G1}-I_{G2} 125°C (nA)	Process No.
2N3921	TO-71	10	700	5.0	10	250	1500		20				100	1.0k	+18	+6.0	50	1.0	10	−3.0		1.5	7.5	35	1000 @ 30			5.0			83
2N3922	TO-71	10	700	5.0	25	250	1500		20				100	1.0k	+18	+6.0	50	1.0	10	−3.0		1.5	7.5	35	1000 @ 30			5.0			83
2N3934	TO-71	10	200	5.0	10	100	300		5.0				See 2N3954-6 as an improved replacement																		
2N3935	TO-71	10	200	5.0	25	100	300		5.0				See 2N3954-6 as an improved replacement																		
2N3954A	TO-71	20	200	5.0	5.0	50					0.5	4.0	150	100	+4.0	+1.2	50	0.5	5.0	1.0	4.5	1.0	3.0	35	100 @ 30	5.0	3.0		10	83
2N3954	TO-71	20	200	5.0	10	50					0.5	4.0	150	100	+4.0	+1.2	50	0.5	5.0	1.0	4.5	1.0	3.0	35	100 @ 30	5.0	3.0		10	83
2N3955A	TO-71	20	200	5.0	15	50					0.5	4.0	150	100	+4.0	+1.2	50	0.5	5.0	1.0	4.5	1.0	3.0	35	100 @ 30	5.0	3.0		10	83
2N3955	TO-71	20	200	10	25	50					0.5	4.0	150	100	+4.0	+1.2	50	0.5	5.0	1.0	4.5	1.0	3.0	35	100 @ 30	5.0	3.0		10	83
2N3956	TO-71	20	200	15	50	50					0.5	4.0	150	100	+4.0	+1.2	50	0.5	5.0	1.0	4.5	1.0	3.0	35	100 @ 30	5.0	5.0		10	83
2N3957	TO-71	20	200	20	75	50					0.5	4.0	150	100	+4.0	+1.2	50	0.5	5.0	1.0	4.5	1.0	3.0	35	100 @ 30	5.0	5.0		10	83
2N3958	TO-71	20	200	25	100	50					0.5	4.0	150	100	+4.0	+1.2	50	0.5	5.0	1.0	4.5	1.0	3.0	35	100 @ 30	10	10		10	83
2N4082	TO-71	10	200	15	10	100	300		10				See 2N3954-6 as an improved replacement																		
2N4083	TO-71	10	200	15	25	100	300		10				See 2N3954-6 as an improved replacement																		
2N4084	TO-71	10	700	15	10	250	1500		20		0.5	4.0	100	1.0k	+18	+6.0	50	1.0	10		3.0	1.5	7.5	35	1000 @ 30			5.0			83
2N4085	TO-71	10	700	15	25	250	1500		20				100	1.0k	+18	+6.0	50	1.0	10		3.0	1.5	7.5	35	1000 @ 30			5.0			83
2N5045	TO-71	15	200	5.0	67								200	10	+8.0	+4.0	50	0.5	8.0	0.5	4.5	1.5	6.0	25	250 @ 30			5.0	1.0		83
2N5046	TO-71	15	200	10	133								200	10	+8.0	+4.0	50	0.5	8.0	0.5	4.5	1.5	6.0	25	250 @ 30			10	2.0		83
2N5047	TO-71	15	200	15	200								200	10	+8.0	+4.0	50	0.5	8.0	0.5	4.5	1.5	6.0	25	250 @ 30			20	3.0		83
2N5196	TO-71	20	200	5.0	5.0	15	700	1500	4.0		0.2	3.8	200	1.0k	+6.0	+2.0	50	0.7	7.0	0.7	4.5	1.0	4.0	50	25 @ 30	5.0	3.0	1.0	5.0	83
2N5197	TO-71	20	200	5.0	10	15	700	1500	4.0		0.2	3.8	20	1.0k	+6.0	+2.0	50	0.7	7.0	0.7	4.5	1.0	4.0	50	25 @ 30	5.0	3.0	1.0	5.0	83
2N5198	TO-71	20	200	10	20	15	700	1500	4.0		0.2	3.8	20	1.0k	+6.0	+2.0	50	0.7	7.0	0.7	4.5	1.0	4.0	50	25 @ 30	5.0	5.0	1.0	5.0	83
2N5199	TO-71	20	200	15	40	15	700	1500	4.0		0.2	3.8	20	1.0k	+6.0	+2.0	50	0.7	7.0	0.7	4.5	1.0	4.0	50	25 @ 30	5.0	5.0	1.0	5.0	83
2N5452	TO-71	20	200	5.0	5.0				1.0		0.2	4.2	20	1.0k	4.0	1.2	50	0.5	5.0	1.0	4.5	1.0	3.0	3.0	100 @ 30	5.0	3.0	0.25		83
2N5453	TO-71	20	200	10	10				1.0		0.2	4.2	20	1.0k	4.0	1.2	50	0.5	5.0	1.0	4.5	1.0	3.0	3.0	100 @ 30	5.0	3.0	0.25		83
2N5454	TO-71	20	200	15	25				1.0		0.2	4.2	20	1.0k	4.0	1.2	50	0.5	5.0	1.0	4.5	1.0	3.0	3.0	100 @ 30	5.0	5.0	0.25		83
•2N5545	TO-71	15	200	5.0	10	50							180	10	+6.0	+2.0	50	0.5	8.0	0.5	4.5	1.5	6.0	25	100 @ 30	5.0	3.0	1.0	5.0	83
•2N5546	TO-71	15	200	10	20	50							200	10	+6.0	+2.0	50	0.5	8.0	0.5	4.5	1.5	6.0	25	100 @ 30	10	5.0	2.0	5.0	83
•2N5547	TO-71	15	200	15	40	50									+6.0	+2.0	50	0.5	8.0	0.5	4.5	1.5	6.0	25	100 @ 30	10	10	3.0	5.0	83
2N5561	TO-71	10	700	5.0	5.0		2.0k	3.0k	4.0				50	10	15	4.0	50	1.0	10	0.8	3.0				100 @ 30	5.0	3.0	0.3		94
2N5562	TO-71	10	700	10	10		2.0k	3.0k	4.0				50	10	15	4.0	50	1.0	10	0.8	3.0				100 @ 30	5.0	3.0	0.4		94
2N5563	TO-71	10	700	15	25		2.0k	3.0k	4.0				50	10	15	4.0	50	1.0	10	0.8	3.0				100 @ 30	5.0	5.0	0.5		94
U231	TO-71	20	200	5.0	10	50	600		10		0.3	4.0	See 2N3954 as an improved replacement																		83
U232	TO-71	20	200	10	25	50	600		10		0.3	4.0	See 2N3955 as an improved replacement																		83
U233	TO-71	20	200	15	50	50	600		10		0.3	4.0	See 2N3956 as an improved replacement																		83
U234	TO-71	20	200	20	75	50	600		10		0.3	4.0	See 2N3957 as an improved replacement																		83
U235	TO-71	20	200	25	100	50	600		10		0.3	4.0	See 2N3958 as an improved replacement																		83
U280	TO-71	20	200	10	10	50	500		1.0	100	0.3	4.0	See 2N5516 as an improved replacement																		83
U281	TO-71	20	200	25	10	50	500		1.0	90	0.3	4.0	See 2N5516 as an improved replacement																		83
U282	TO-71	20	200	10	20	50	500		1.0	90	0.3	4.0	See 2N5517 as an improved replacement																		83

•**Note:** MIL JAN, TXJAN parts in process of qualification. Consult factory representative for delivery status.

N-Channel FETs

LOW FREQUENCY — LOW NOISE DUAL JFETS

Type No.	Case Style	OPERATING CONDITIONS FOR THESE CHARACTERISTICS: OP. CHAR. V_{DG} (V)	OP. CHAR. I_D (μA)	$\lvert V_{GS1-2} \rvert$ V_{OS} (mV) Max	DRIFT (μV/°C) ΔV_{GS} Max	I_G (pA) Max	G_{fs} μmhos Min	G_{fs} μmhos Max	G_{oss} (μmho) Max	CMRR (dB) Min	V_{gs} (V) Min	V_{gs} (V) Max	$\bar{e}_n$ (nV/√Hz) @ f Max	(Hz)	C_{iss} (pF) Max	C_{rss} (pF) Max	BV (V) Min	I_{DSS} (mA) Min	I_{DSS} (mA) Max	V_p (V) Min	V_p (V) Max	G_{fs} (μmho) Min	G_{fs} (μmho) Max	G_{oss} (μmho) Max	I_{GSS} (pA) @ V_{DG} Max	@ (V)	I_{DSS} Match %	G_{fs} Match %	G_{oss1-2} (μmho)	$I_{G1-I_{G2}}$ 125°C (nA)	Process No.
2N5515	TO-71	20	200	5.0	5.0	100	500	1000	1.0	100	0.2	3.8	30	10	+25	+5.0	40	0.5	7.5	0.7	4.0	1.0	4.0	10	250	30	5.0	3.0	0.1	10	95
2N5516	TO-71	20	200	5.0	10	100	500	1000	1.0	100	0.2	3.8		10	+25	+5.0	40	0.5	7.5	0.7	4.0	1.0	4.0	10	250	30	5.0	3.0	0.1	10	95
2N5517	TO-71	20	200	10	20	100	500	1000	1.0	90	0.2	3.8		10	+25	+5.0	40	0.5	7.5	0.7	4.0	1.0	4.0	10	250	30	5.0	5.0	0.1	10	95
2N5518	TO-71	20	200	15	40	100	500	1000	1.0		0.2	3.8		10	+25	+5.0	40	0.5	7.5	0.7	4.0	1.0	4.0	10	250	30	5.0	5.0	0.1	10	95
2N5519	TO-71	20	200	15	80	100	500	1000	1.0		0.2	3.8		10	+25	+5.0	40	0.5	7.5	0.7	4.0	1.0	4.0	10	250	30	10	10	0.1	10	95
2N5520	TO-71	20	200	5.0	5.0	100	500	1000	1.0	100	0.2	3.8	15	10	+25	+5.0	40	0.5	7.5	0.7	4.0	1.0	4.0	10	250	30	5.0	3.0	0.1	10	95
2N5521	TO-71	20	200	5.0	10	100	500	1000	1.0	100	0.2	3.8		10	+25	+5.0	40	0.5	7.5	0.7	4.0	1.0	4.0	10	250	30	5.0	3.0	0.1	10	95
2N5522	TO-71	20	200	10	20	100	500	1000	1.0	90	0.2	3.8		10	+25	+5.0	40	0.5	7.5	0.7	4.0	1.0	4.0	10	250	30	5.0	5.0	0.1	10	95
2N5523	TO-71	20	200	15	40	100	500	1000	1.0		0.2	3.8		10	+25	+5.0	40	0.5	7.5	0.7	4.0	1.0	4.0	10	250	30	5.0	5.0	0.1	10	95
2N5524	TO-71	20	200	15	80	100	500	1000	1.0		0.2	3.8		10	+25	+5.0	40	0.5	7.5	0.7	4.0	1.0	4.0	10	250	30	10	10	0.1	10	95
2N6483	TO-71	20	200	5.0	5.0	100	500	1500	1.0	100	0.2	3.8	10	10	20	3.5	50	0.5	7.5	0.7	4.0	1.0	4.0	10	200	30	5.0	3.0	0.1	10	95
2N6484	TO-71	20	200	10	10	100	500	1500	1.0	100	0.2	3.8		10	20	3.5	50	0.5	7.5	0.7	4.0	1.0	4.0	10	200	30	5.0	3.0	0.1	10	95
2N6485	TO-71	20	200	15	25	100	500	1500	1.0	90	0.2	3.8		10	20	3.5	50	0.5	7.5	0.7	4.0	1.0	4.0	10	200	30	5.0	5.0	0.1	10	95
IMF6485	TO-71	20	200	25	40	100	500	1500	1.0	80	0.2	3.8		10	20	3.5	50	0.5	7.5	0.7	4.0	1.0	4.0	10	200	30	10	10	0.2	10	95

N-Channel FETs

WIDE BAND — LOW NOISE DUAL JFETS

Type No.	Case Style	OPERATING CONDITIONS FOR THESE CHARACTERISTICS: OP. CHAR. V_{DG} (V)	OP. CHAR. I_D (μA)	$\lvert V_{GS1-2} \rvert$ V_{OS} (mV) Max	DRIFT (μV/°C) ΔV_{GS} Max	I_G (pA) Max	G_{fs} μmhos Min	G_{fs} μmhos Max	G_{oss} (μmho) Max	CMRR (dB) Min	V_{gs} (V) Min	V_{gs} (V) Max	$\bar{e}_n$ (nV/√Hz) @ f Max	(Hz)	C_{iss} (pF) Max	C_{rss} (pF) Max	BV (V) Min	I_{DSS} (mA) Min	I_{DSS} (mA) Max	V_p (V) Min	V_p (V) Max	G_{fs} (μmho) Min	G_{fs} (μmho) Max	G_{oss} (μmho) Max	I_{GSS} (pA) @ V_{DG} Max	@ (V)	I_{DSS} Match %	G_{fs} Match %	G_{oss1-2} (μmho)	$I_{G1-I_{G2}}$ 125°C (nA)	Process No.
2N5564	TO-71	15	2000	5.0	10		7500		45				50	10	12	3.0	40	5.0	30	0.5	3.0				100	20	5.0	5.0			96
2N5565	TO-71	15	2000	10	25		7500		45				50	10	12	3.0	40	5.0	30	0.5	3.0				100	20	5.0	10			96
2N5566	TO-71	15	2000	20	50		7500		45				50	10	12	3.0	40	5.0	30	0.5	3.0				100	20	5.0	10			96
2N5911	TO-78	10	5000	10	20	100	5000	10,000	100		0.3	4.0	20	10k	5.0	1.2	25	7.0	40	1.0	5.0				100	15	5.0	5.0	20	20	93
2N5912	TO-78	10	5000	15	40	100	5000	10,000	100		0.3	4.0	20	10k	5.0	1.2	25	7.0	40	1.0	5.0				100	15	5.0	5.0	20	20	93
U257	TO-78	10	5000	100			5000	10,000	150				30	10k	5.0	1.2	25	5.0	40	1.0	5.0				100	15	15	15	20		93

N-Channel FETs

LOW LEAKAGE — HIGH CMRR — WIDE BAND DUAL JFETS

Type No.	Case Style	OPERATING CONDITIONS FOR THESE CHARACTERISTICS: OP. CHAR. V_{DG} (V)	OP. CHAR. I_D (μA)	$\lvert V_{GS1-2}\rvert$ V_{OS} (mV) Max	DRIFT (μV/ C) ΔV_{GS} Max	I_G (pA) Max	G_{fs} μmhos Min	G_{fs} μmhos Max	G_{oss} (μmho) Max	CMRR (dB) Min	V_{gs} (V) Min	V_{gs} (V) Max	$\bar{e}_n$ (nV/√Hz)@ f Max	f (Hz)	C_{iss} (pF) Max	C_{rss} (pF) Max	BV (V) Min	I_{DSS} (mA) Min	I_{DSS} (mA) Max	V_p (V) Min	V_p (V) Max	G_{fs} (μmho) Min	G_{fs} (μmho) Max	G_{oss} (μmho) Max	I_{GSS} (pA) Max @ V_{DG} (V)	I_{DSS} Match %	G_{fs} Match %	G_{oss1-2} (μmho)	I_{G1}-I_{G2} 125°C (nA)	Process No.
NDF9401	TO-78	20	200	5.0	5.0	5.0[3]	950	2000	0.1	120	0.1	3.0	30	10	5.0	0.02	50	0.5	10	0.5	4.0				10 @ 30	5.0	3.0	0.1	1.0	94
NDF9402	TO-78	20	200	5.0	10	5.0[3]	950	2000	0.1	120	0.1	3.0	30	10	5.0	0.02	50	0.5	10	0.5	4.0				10 @ 30	5.0	3.0	0.1	1.0	94
NDF9403	TO-78	20	200	10	10	5.0[3]	950	2000	0.1	110	0.1	3.0	30	10	5.0	0.02	50	0.5	10	0.5	4.0				10 @ 30	5.0	5.0	0.1	1.0	94
NDF9404	TO-78	20	200	15	10	5.0[3]	950	2000	0.1	110	0.1	3.0	30	10	5.0	0.02	50	0.5	10	0.5	4.0				10 @ 30	5.0	5.0	0.1	1.0	94
NDF9405	TO-78	20	200	25	25	5.0[3]	950	2000	0.1	100	0.1	3.0	30	10	5.0	0.02	50	0.5	10	0.5	4.0				10 @ 30	5.0	5.0	0.1	1.0	94
NDF9406	TO-71	20	200	5.0	5.0	5.0[3]	950	2000	0.1	120	0.1	3.0	30	10	5.0	0.02	50	0.5	10	0.5	4.0				10 @ 30	10	10	0.1	1.0	94
NDF9407	TO-71	20	200	5.0	10	5.0[3]	950	2000	0.1	120	0.1	3.0	30	10	5.0	0.02	50	0.5	10	0.5	4.0				10 @ 30	5.0	3.0	0.1	1.0	94
NDF9408	TO-71	20	200	10	10	5.0[3]	950	2000	0.1	110	0.1	3.0	30	10	5.0	0.02	50	0.5	10	0.5	4.0				10 @ 30	5.0	3.0	0.1	1.0	94
NDF9409	TO-71	20	200	15	10	5.0[3]	950	2000	0.1	110	0.1	3.0	30	10	5.0	0.02	50	0.5	10	0.5	4.0				10 @ 30	5.0	5.0	0.1	1.0	94
NDF9410	TO-71	20	200	25	25	5.0[3]	950	2000	0.1	100	0.1	3.0	30	10	5.0	0.02	50	0.5	10	0.5	4.0				10 @ 30	10	10	0.1	1.0	94

N-Channel FETs

ULTRA-LOW LEAKAGE DUALS

Type No.	Case Style	*BV_{DGO} BV_{GSS} (V) Min	I_{GSS} *I_{DGO} (pA) Max	@ V_{GS} (V)	V_p (V) Min	V_p (V) Max	I_{DSS} (mA) Min	I_{DSS} (mA) Max	G_{fs} (mmho) Min	G_{fs} (mmho) Max	G_{oss} (μmho Max	C_{iss} (pF) Max	C_{rss} (pF) Max	Oper. Cond. V_{DG} (V)	Oper. Cond. I_D (μA)	I_G (pA) Max	V_{GS} (V) Min	V_{GS} (V) Max	$\lvert V_{GS1-2}\rvert$ V_{OS} (mV) Max	ΔV_{GS} DRIFT (μV/°C) Max	I_{G1}-I_{G2} @ 125°C (nA) Max	G_{oss} (μmho) Max	G_{fs} (mmho) Min	Process No.
•2N5902	TO-78	40	5	20	0.6	4.5	30μ	0.5	70μ	0.25	5	3	1.5	10	30	3		4	5	5	2	1	50μ	84
•2N5903	TO-78	40	5	20	0.6	4.5	30μ	0.5	70μ	0.25	5	3	1.5	10	30	3		4	5	10	2	1	50μ	84
•2N5904	TO-78	40	5	20	0.6	4.5	30μ	0.5	70μ	0.25	5	3	1.5	10	30	3		4	10	20	2	1	50μ	84
•2N5905	TO-78	40	5	20	0.6	4.5	30μ	0.5	70μ	0.25	5	3	1.5	10	30	3		4	15	40	2	1	50μ	84
•2N5906	TO-78	40	2	20	0.6	4.5	30μ	0.5	70μ	0.25	5	3	1.5	10	30	1		4	5	5	0.2	1	50μ	84
•2N5907	TO-78	40	2	20	0.6	4.5	30μ	0.5	70μ	0.25	5	3	1.5	10	30	1		4	5	10	0.2	1	50μ	84
•2N5908	TO-78	40	2	20	0.6	4.5	30μ	0.5	70μ	0.25	5	3	1.5	10	30	1		4	10	20	0.2	1	50μ	84
•2N5909	TO-78	40	2	20	0.6	4.5	30μ	0.5	70μ	0.25	5	3	1.5	10	30	1		4	15	40	0.2	1	50μ	84
FM1100A	TO-78	*35			0.5	3	0.1	1.2	0.5	3	1	5	0.6	15	100	1¶			2	5	0.04			82
FM1101A	TO-78	*35			0.5	3	0.1	1.2	0.5	3	1	5	0.6	15	100	1¶			5	5	0.04			82
FM1102A	TO-78	*35			0.5	3	0.1	1.2	0.5	3	1	5	0.6	15	100	1¶			10	5	0.04			82
FM1103A	TO-78	*35			0.5	3	0.1	1.2	0.5	3	1	5	0.6	15	100	1¶			10	20	0.04			82
FM1104A	TO-78	*35			0.5	3	0.1	1.2	0.5	3	1	5	0.6	15	100	1¶			25	50	0.04			82
FM1105A	TO-78	*35			1	6	1	10	1	6	1	5	0.6	15	100	1¶			2	5	0.04			82
FM1106A	TO-78	*35			1	6	1	10	1	6	1	5	0.6	15	100	1¶			5	5	0.04			82
FM1107A	TO-78	*35			1	6	1	10	1	6	1	5	0.6	15	100	1¶			10	5	0.04			82
FM1108A	TO-78	*35			1	6	1	10	1	6	1	5	0.6	15	100	1¶			10	20	0.04			82
FM1109A	TO-78	*35			1	6	1	10	1	6	1	5	0.6	15	100	1¶			25	50	0.04			82
FM1110A	TO-78	*35			0.5	10	0.1	10	0.5	6		5	0.6	15	100	1¶			10	20	0.04			82
FM1111A	TO-78	*35			0.5	10	0.1	10	0.5	6		5	0.6	15	100	1¶			50	100	0.04			82

•Devices under development. Consult factory representative for delivery status. ¶ V_{DG} = 35V *Not recommended for new design.

P-Channel FETs

SWITCHES

Transistor Type	Case Style	BV_{GSS} *BV_{GDO} (V) Min	@ I_G (μA)	I_{GSS} *I_{DGO} (nA) Max	@ V_{DG} (V)	$I_{D(off)}$ (nA) Max	@ V_{DS} (V)	V_{GS} (V)	V_p (V) Min	Max	@ V_{DS} (V)	I_D (μA)	I_{DSS} (mA) Min	Max	@ V_{DS} (V)	r_{ds} (Ω) Max	@ I_D (mA)	C_{iss} (pF) Max	@ V_{DS} (V)	V_{GS} (V)	C_{rss} (pF) Max	@ V_{DS} (V)	V_{GS} (V)	t_{on} (ns) Max	t_{off} (ns) Max	Process No.
2N3382	TO-72	30	1	15	30	2	−5	6	1	5	−5	1	3	30	10	300										88
2N3384	TO-72	30	1	15	30	2	−5	6	4	5	−5	1	15	30	10	180										88
2N3386	TO-72	30	1	15	30	2.5	−5	10	4	9.5	−5	1	15	50	10	150										88
2N3993	TO-72	25	1	1.2*	15	1.2	−10	10	4	9.5	−10	1	10		10	150		16	−10	0	4.5	0	10			88
2N3993A	TO-72	25	1	1.2*	15	1.2	−10	10	4	9.5	−10	1	10		10	150		12	−10	0	3	0	10			88
2N3994	TO-72	25	1	1.2*	15	1.2	−10	6	1	5.5	−10	1	2		10	300		16	−10	0	4.5	0	10			88
2N3994A	TO-72	25	1	1.2*	15	1.2	−10	6	1	5.5	−10	1	2		10	300		12	−10	0	3	0	10			88
2N5018	TO-18	30	1	2	15	10	−15	12		10	−15	1	10		20	75		45	−15	0	10	0	12	35	65	88
2N5019	TO-18	30	1	2	15	10	−15	7		5	−15	1	5		20	150		45	−15	0	10	0	7	90	125	88
•2N5114	TO-18	30	1	0.5	20	0.5	−15	12	5	10	−15	.001	30	90	18	75	1	25	−15	0	7	0	12	16	21	88
•2N5115	TO-18	30	1	0.5	20	0.5	−15	7	3	6	−15	.001	16	60	15	100	1	25	−15	0	7	0	7	30	38	88
•2N5116	TO-18	30	1	0.5	20	0.5	−15	5	1	4	−15	.001	5	25	15	150	1	25	−15	0	7	0	5	42	60	88
P1086E	TO-106	30	1	2	20	10	−15	10		10	−15	.01	10		15	75	1	45	−15	0	10	15	0	35	50	88
P1087E	TO-106	30	1	2	20	10	−15	5		5	−15	.01	5		15	150		45	−15	0	10	15	0	40	75	88
PF510	TO-18	30	1	10	15				0.5	10	−15	.01	5		10	200	0.5	15	−10	0	4	0	12			88
UC451	TO-18	25	1	0.25	20					6	−20	.001	3.75	37.5	20	150		25	−20	0	7	10				88

•**Note:** MIL JAN, TX JAN parts in process of qualification. Consult factory representative for delivery status.

P-Channel FETs

AMPLIFIERS

Transistor Type	Case Style	BV_{GSS} *BV_{GDO} (V) Min	@ I_G (μA)	I_{GSS} *I_{DGO} (nA) Max	@ V_{DG} (V)	V_p (V) Min	Max	@ V_{DS} (V)	I_D (μA)	I_{DSS} (mA) Min	Max	@ V_{DS} (V)	G_{fs} (mmho) Min	Max	@ V_{DS} (V)	G_{oss} (μmho) Max	@ V_{DS} (V)	C_{iss} (pF) Max	V_{DS} (V)	V_{GS} (V)	C_{rss} (pF) Max	V_{DS} (V)	V_{GS} (V)	e_n $\left(\frac{NV}{\sqrt{Hz}}\right)$ Max	@ Freq (Hz)	Process No.
•2N2608	TO-18	30	1	10	30	1	4	−5	1	0.9	4.5	5	1		5			17	−5	1				125	1000	89
•2N2609	TO-18	30	1	30	30	1	4	−5	1	2	10	5	2.5		5			30	−5	1				125	1000	88
2N3329	TO-72	20	10	10	10		5	−15	10	1	3	10	1	2	10/1mA	20	10	20	−10	1				125	1000	89
2N3330	TO-72	20	10	10	10		6	−15	10	2	6	10	1.5	3	10/2mA	40	10	20	−10	1				125	1000	89
2N3331	TO-72	20	10	10	10		8	−15	10	5	15	10	2	4	10/5mA	100	10	20	−10	1				155	1000	89
2N3332	TO-72	20	10	10	10		6	−15	10	1	6	10	1	2.2	10/1mA	20	10	20	−10	1				65	1000	89
2N3820	TO-106	20	10	20	10		8	−10	10	0.3	15	10	0.8	5	10	200	10	32	−10	0	16	−10	0			89
2N4342	TO-106	25	10	10	15		5.5	−10	1	4	12	10	2	6	10	75	10	20	−10	0	5	−10	0	80	100	89
2N4343	TO-106	25	10	10	15		10	−10	1	10	30	10	4	8	10	100	10	20	−10	0	5	−10	0	80	100	88

•**Note:** MIL JAN TXJAN parts in process of qualification. Consult factory representative for delivery status.

AMPLIFIERS (Cont.)

P-Channel FETs

Transistor Type	Case Style	BV_{GSS} *BV_{GDO} (V) Min	@ I_G (μA)	I_{GSS} *I_{DGO} (nA) Max	@ V_{DG} (V)	V_P (V) Min	Max	@ V_{DS} (V)	I_D (μA)	I_{DSS} (mA) Min	Max	@ V_{DS} (V)	G_{fs} (mmho) Min	Max	@ V_{DS} (V)	G_{oss} (μmho) Max	@ V_{DS} (V)	C_{iss} (pF) Max	V_{DS} (V)	V_{GS} (V)	C_{rss} (pF) Max	V_{DS} (V)	V_{GS} (V)	$\bar{e}_n$ $\left(\frac{NV}{\sqrt{Hz}}\right)$ Max	@ Freq (Hz)	Process No.
2N4360	TO-106	20	10	10	15	0.7	10	−10	1	3	30	10	2	8	10	100	10	20	−10	0	5	−10	0	190	100	89
2N4381	TO-18	25	1	1	15	1	5	−15	1	3	12	15	2	6	15	75	15	20	−15	0	5	−15	0	20	1000	89
2N4382	TO-18	25	1	1	15	2.5	9	−15	1	10	30	15	4	8	15	100	15	20	−15	0	5	−15	0	20	1000	89
2N5020	TO-18	25	1	1	15	0.3	1.5	−15	1	0.3	1.2	15	1	3.5	15	20	15	25	−15	0	7	−15	0	30	1000	89
2N5021	TO-18	25	1	1	15	0.5	2.5	−15	1	1	3.5	15	1.5	6	15	20	15	25	−15	0	7	−15	0	30	1000	89
2N5033	TO-106	20	10	10	15	0.3	2.5	−10	1	0.3	3.5	10	1	5	10	20	10	25	−10	0	7	−10	0	100	1000	89
2N5460	TO-92	40	10	5	20	0.75	6	−15	1	1	5	15	1	4	15	50	15	7	−15	0	2	−15	0	115	100	89
2N5461	TO-92	40	10	5	20	1	7.5	−15	1	2	9	15	1.5	5	15	50	15	7	−15	0	2	−15	0	115	100	89
2N5462	TO-92	40	10	5	20	1.8	9	−15	1	4	16	15	2	6	15	50	15	7	−15	0	2	−15	0	115	100	89
UC450	TO-18	25	1	0.25	20	5	10	−20	.001	25	75	20	10	10	20			25	−20	0	7	0	10			88
UC451	TO-18	25	1	0.25	20	1	6	−20	.001	3.75	37.5	20	6	6	20			25	−20	0	7	0	10			88

Pro-Electron Series

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} h_{fe} (1kHz)* Min	Max	@ I_C (mA)	V_{CE} (V)	$V_{CE(sat)}$ (V) Max	$V_{BE(sat)}$ $V_{BE(on)}$* (V) Min	Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
BC107	TO-18	50	45	6	15	50	125	900*	2	5	0.2			10	4.5	150		10		10	1	04
					I_{CES}						0.6			100								
												0.55	0.7*	2								
BC107A	TO-18	50	45	6	15	50	125	260*	2	5	0.2			10	4.5	150		10		10	1	04
					I_{CES}						0.6			100								
												0.55	0.7*	2								
BC107B	TO-18	50	45	6	15	50	240	500*	2	5	0.2			10	4.5	150		10		10	1	04
					I_{CES}						0.6			100								
												0.55	0.7*	2								
BC108	TO-18	30	20	5	15	30	125	900*	2	5	0.2			10	4.5	150		10		10	1	04
					I_{CES}						0.6			100								
												0.55	0.7*	2								
BC108A	TO-18	30	20	5	15	30	125	260*	2	5	0.2			10	4.5	150		10		10	1	04
					I_{CES}						0.6			100								
												0.55	0.7*	2								
BC108B	TO-18	30	20	5	15	30	240	500*	2	5	0.2			10	4.5	150		10		10	1	04
					I_{CES}						0.6			100								
												0.55	0.7*	2								
BC108C	TO-18	30	20	5	15	30	450	900*	2	5	0.2			10	4.5	150		10		10	1	04
					I_{CES}						0.6			100								
												0.55	0.7*	2								
BC109	TO-18	30	20	5	15	30	240	900*	2	5	0.2			10	4.5	150		10		4	1	04
					I_{CES}						0.6			100								
												0.55	0.7*	2								

BC109B	TO-18	30	20	5	15 I_{CES}	30	240	500*	2	5	0.2 0.6	0.55	0.7*	10 100 2	4.5	150	10		4 4	1 2	04
BC109C	TO-18	30	20	5	15 I_{CES}	30	450	900*	2	5	0.2 0.6	0.55	0.7*	10 100 2	4.5	150	10		4 4	1 2	04
BC113	TO-106	30	25	6	200	5	200	1000	1	10	0.35			1	4						07
BC114	TO-106	30	25	6	200	5	200	1000	1	10	0.35			1	4	60	0.05		3	3	07
BC115	TO-105	40	30	5	100	20	50 100 50	400	1 10 100	10 10 10	1		0.9	100	25						20
BC116	TO-105	60	40	5	100	20	20 35 40	120	0.1 10 150	10 10 10	0.4 1.6		1	150 500 50	8	200	30				63
BC118	TO-106	45	45	4	500	30	40	160	10	10					3.5	200	10				23
BC125A	TO-105	50	40	5	50	20	40 40	150	10 50	10 1	0.5		1.3 1*	150 50	25	40	50				20
BC125B	TO-105	60	30	6	50	40	45 40	120	10 150	1 1	0.25 0.8		1 1.3	150 500	8	200	50				20
BC126	TO-105	35		5	50	20	30 30 25 30	120	50 150 1 10	1 1 10 10	0.5 0.25		1.3 1*	150 50 50							63
BC126A	TO-105	40	40	5	50	10	50 50	150	10 50	10 1	0.5		1.3 1*	150 50							63
BC132	TO-106	30	25	6	50	5	60	300	1	10	0.35			1	4	40	1				04
BC136	TO-105	60		5	50	30	30		10	10	1.5		1.2	500 150	25						20
BC137	TO-105	40	40	4	50	30	25 30		50 10	4 10	2		1.3	500 150	10						63
BC140	TO-39	80 BV_{CES}	40	7	100 I_{CES}	60	40	250	100	1	1		1.8*	1A	25	50	50	850		19	14
BC140-6	TO-39	80 BV_{CES}	40	7	100 I_{CES}	60	40	100	100	1	1		1.8*	1A	25	50	50	850		19	14
BC140-10	TO-39	80 BV_{CES}	40	7	100 I_{CES}	60	63	160	100	1	1		1.8*	1A	25	50	50	850		19	14
BC140-16	TO-39	80 BV_{CES}	40	7	100 I_{CES}	60	100	250	100	1	1		1.8*	1A	25	50	50	850		19	14
BC141	TO-39	100 BV_{CES}	60	7	100 I_{CES}	60	40	250	100	1	1		1.8*	1A	25	50	50	850		19	14
BC141-6	TO-39	100 BV_{CES}	60	7	100 I_{CES}	60	40	100	100	1	1		1.8*	1A	25	50	50	850		19	14

Test Conditions:

1. I_C = 200μA, V_{CE} = 5.0V, R_S = 2.0 kΩ, f = 1.0 kHz, BW = 200 Hz
2. I_C = 200μA, V_{CE} = 5.0V, R_S = 2.0 kΩ, W.B.
3. I_C = 30μA, V_{CE} = 5.0V, R_S = 10 kΩ, f = 1.0 kHz, BW = 200 Hz
4. I_C = 20μA, V_{CE} = 5.0V, R_S = 10 kΩ, f = 1.0 kHz, BW = 150 Hz
5. I_C = 200μA, V_{CE} = 5.0V, R_G = 2.0 kΩ, f = 20 Hz to 15 kHz
6. I_C = 100μA, V_{CE} = 5.0V, R_S = 2.0 kΩ, f = 10 Hz to 10 kHz
7. I_C = 50μA, V_{CE} = 5.0V, R_S = 10 kΩ, BW = 10 Hz to 15 kHz
8. I_C = 50μA, V_{CE} = 5.0V, R_S = 10 kΩ, f = 1.0 kHz, BW = 200 Hz
9. I_C = 200μA, V_{CE} = 2.0V, R_S = 2.0 kΩ, f = 1.0 kHz, BW = 200 Hz
10. I_C = 10μA, V_{CE} = 5.0V, R_S = 10 kΩ, W.B.
11. I_C = 150 mA, V_{CE} = 10V, $I_{B1} = I_{B2}$ = 15 mA
12. I_C = 150 mA, $I_{B1} = I_{B2}$ = ±7.5 mA
13. I_C = 10 mA, I_{B1} = 3.0 mA, I_{B2} = 1.0 mA
14. I_C = 100 mA, I_{B1} = 40 mA, I_{B2} = 20 mA
15. V_{CC} = 10V, I_C = 100 mA $I_{B1} = I_{B2}$ = 10 mA
16. I_C = 150 mA, V_{CE} = 6.0V, $I_{B1} = I_{B2}$ = 15 mA
17. I_C = 10 mA, I_{B1} = 1.0 mA, I_{B2} = −1.0 mA
18. I_C = 300 mA, V_{CC} = 25V, $I_{B1} = I_{B2}$ = 30 mA
19. V_{CC} = 20V, I_C = 100 mA $I_{B1} = I_{B2}$ = 5.0 mA
20. I_C = 1.0 mA, V_{CE} = 5.0V, R_G = 2.0 kΩ, f = 1.0 kHz, BW = 200 Hz
21. I_C = 20μA, V_{CE} = 5.0V, R_S = 10 kΩ,
    a – f = 1.0 kHz, BW = 200 Hz
    b – f = 10 kHz, BW = 2.0 kHz
    c – BW = 15.7 kHz
22. I_C = 500 mA, V_{CC} = 25V, I_{B1} = 50 mA, I_{B2} = 25 mA

*Electrically but not identical to pro-electron type numbers.

Pro-Electron Series

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) @ V_{CB} (V) Max	h_{FE} h_{fe} (1kHz)* Min	Max	@ I_C (mA)	V_{CE} (V)	$V_{CE(sat)}$ (V) Max	$V_{BE(sat)}$ $V_{BE(on)}$* (V) Min	Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
BC141-10	TO-39	100 BV_{CES}	60	7	100 @ 60 I_{CES}	63	160	100	1	1		1.8*	1A	25	50	50		850		19	14
BC143	TO-5	60	60	5	50 @ 40	20		200	2	1.5			500		60	50					63
												1.5	200								
BC153	TO-106	40	40	5	20 @ 40	50		0.1	5	0.25			10						3	4	62
						50		1	5												
BC154	TO-106	40	40	5	10 @ 40	160		0.1	5	0.25			10						2.5	4	62
						160		1	5												
BC160	TO-39	40	40	5	100 @ 40 I_{CES}	40	250	100	1	1		1.7*	1A	30	50	50		650		19	67
BC160-6	TO-39	40	40	5	100 @ 40 I_{CES}	40	100	100	1	1		1.7*	1A	30	50	50		650		19	67
BC160-10	TO-39	40	40	5	100 @ 40 I_{CES}	63	160	100	1	1		1.7*	1A	30	50	50		650		19	67
BC160-16	TO-39	40	40	5	100 @ 40 I_{CES}	100	250	100	1	1		1.7*	1A	30	50	50		650		19	67
BC161	TO-39	60	60	5	100 @ 60 I_{CES}	40	250	100	1	1		1.7*	1A	30	50	50		650		19	67
BC161-6	TO-39	60	60	5	100 @ 60 I_{CES}	40	100	100	1	1		1.7*	1A	30	50	50		650		19	67
BC161-10	TO-39	60	60	5	100 @ 60 I_{CES}	63	160	100	1	1		1.7*	1A	30	50	50		650		19	67
BC161-16	TO-39	60	60	5	100 @ 60 I_{CES}	100	250	100	1	1		1.7*	1A	30	50	50		650		19	67
BC167A	TO-92(74)		45	6	15 @ 50 I_{CES}	125	260*	2	5	0.2			10	4.5	150	10			10	1	04
										0.6			100								
BC167B	TO-92(74)		45	6	15 @ 50 I_{CES}	240	500*	2	5	0.2			10	4.5	150	10			10	1	04
										0.6			100								
BC168A	TO-92(74)		20	5	15 @ 30 I_{CES}	125	260*	2	5	0.2			10	4.5	150	10			10	1	04
										0.6			100								
BC168B	TO-92(74)		20	5	15 @ 30 I_{CES}	240	500*	2	5	0.2			10	4.5	150	10			10	1	04
										0.6			100								
BC168C	TO-92(74)		20	5	15 @ 30 I_{CES}	450	900*	2	5	0.2			10	4.5	150	10			10	1	04
										0.6			100								
BC169B	TO-72(74)		20	5	15 @ 30 I_{CES}	240	500*	2	5	0.2			10	4.5	150	10			4	1	04
										0.6			100						4	2	
BC169C	TO-72(74)		20	5	15 @ 30 I_{CES}	450	900*	2	5	0.2			10	4.5	150	10			4	1	04
										0.6			100						4	2	
BC170	TO-106	20	20	5	100 @ 15	35	600	1	1	0.25		0.7	1								04
						30		30	1	0.4			30								
BC170A	TO-106	20	20	5	100 @ 15	35	100	1	1	0.25		0.7	1								04
						30		30	1	0.4			30								
BC170B	TO-106	20	20	5	100 @ 15	80	250	1	1	0.25		0.7	1								04
						60		30	1	0.4			30								
BC170C	TO-106	20	20	5	100 @ 15	200	600	1	1	0.25		0.7	1								04
						150		30	1	0.4			30								

BC171	TO-106		45	5	15	45	125	500*	2	5	0.25 0.6			10 100 2		150	10		6	1	04
BC171A	TO-106		45	5	15	45	40 125	260*	0.01 2	5 5	0.25 0.6	0.55	0.7*	10 100 2		150	10		6	1	04
BC171B	TO-106		45	5	15	45	40 240	500*	0.01 2	5 5	0.25 0.6	0.55	0.7*	10 100 2		150	10		6	1	04
BC171C	TO-106		45	5	15 I_{CES}	50	100 450	900*	0.01 2	5 5	0.25 0.6	0.55	0.7*	10 100 2	4.5	150	10		10	1	04
BC172	TO-106		20	5	15	20	125	900*	2	5	0.25 0.6	0.55	0.7*	10 100 2		150	10		6	1	04
BC172A	TO-106		20	5	15	20	40 125	260*	0.01 2	5 5	0.25 0.6	0.55	0.7*	10 100 2		150	10		6	1	04
BC172B	TO-106		20	5	15	20	40 240	500*	0.01 2	5 5	0.25 0.6	0.55	0.7*	10 100 2		150	10		6	1	04
BC172C	TO-106		20	5	15	20	100 450	900*	0.01 2	5 5	0.25 0.6	0.55	0.7*	10 100 2		150	10		6	1	04
BC173	TO-106		20	5	15	20	40 240	900*	0.01 2	5 5	0.25 0.6	0.55	0.7*	10 100 2		150	10		4	2	04
BC173A	TO-106		20	5	15	20	40 125	260*	0.01 2	5 5	0.25 0.6	0.55	0.7*	10 100 2		150	10		4 4	2 1	04
BC173B	TO-106		20	5	15	20	40 240	500*	0.01 2	5 5	0.25 0.6	0.55	0.7*	10 100 2		150	10		4	2	04
BC173C	TO-106		20	5	15	20	100 450	900*	0.01 2	5 5	0.25 0.6	0.55	0.7*	10 100 2		150	10		4	2	04
BC177	TO-18	50	45 BV_{CES} 50	5	100 I_{CES}	20	75	260*	2	5	V_{CEK} 0.6	0.6	0.75*	2 10	6				10	1	71
BC177A	TO-18	50	45 BV_{CES} 50	5	100 I_{CES}	20	125	260*	2	5	V_{CEK} 0.6	0.6	0.75*	2 10	6				10	1	71
BC177B	TO-18	50	45	5	100	20	180	460	2	5		0.6	0.75*	2	6				10	1	71
BC177-VI	TO-18	50	45 BV_{CES} 50	5	100 I_{CES}	20	75	150*	2	5	V_{CEK} 0.6	0.6	0.75*	2 10	6				10	1	71

Test Conditions

1. I_C = 200μA, V_{CE} = 5.0V, R_S = 2.0 kΩ, f = 1.0 kHz, BW = 200 Hz
2. I_C = 200μA, V_{CE} = 5.0V, R_S = 2.0 kΩ, W.B.
3. I_C = 30μA, V_{CE} = 5.0V, R_S = 10 kΩ, f = 1.0 kHz, BW = 200 Hz
4. I_C = 20μA, V_{CE} = 5.0V, R_S = 10 kΩ, f = 1.0 kHz, BW = 150 Hz
5. I_C = 200μA, V_{CE} = 5.0V, R_G = 2.0 kΩ, f = 20 Hz to 15 kHz
6. I_C = 100μA, V_{CE} = 5.0V, R_S = 2.0 kΩ, f = 10 Hz to 10 kHz
7. I_C = 50μA, V_{CE} = 5.0V, R_S = 10 kΩ, BW = 10 Hz to 15 kHz
8. I_C = 50μA, V_{CE} = 5.0V, R_S = 10 kΩ, f = 1.0 kHz, BW = 200 Hz
9. I_C = 200μA, V_{CE} = 2.0V, R_S = 2.0 kΩ, f = 1.0 kHz, BW = 200 Hz
10. I_C = 10μA, V_{CE} = 5.0V, R_S = 10 kΩ, W.B.
11. I_C = 150 mA, V_{CE} = 10V, I_{B1} = I_{B2} = 15 mA
12. I_C = 150 mA, I_{B1} = I_{B2} = ±7.5 mA
13. I_C = 10 mA, I_{B1} = 3.0 mA, I_{B2} = 1.0 mA
14. I_C = 100 mA, I_{B1} = 40 mA, I_{B2} = 20 mA
15. V_{CC} = 10V, I_C = 100 mA I_{B1} = I_{B2} = 10 mA
16. I_C = 150 mA, V_{CE} = 6.0V, I_{B1} = I_{B2} = 15 mA
17. I_C = 10 mA, I_{B1} = 1.0 mA, I_{B2} = −1.0 mA
18. I_C = 300 mA, V_{CC} = 25V, I_{B1} = I_{B2} = 30 mA
19. V_{CC} = 20V, I_C = 100 mA I_{B1} = I_{B2} = 5.0 mA
20. I_C = 1.0 mA, V_{CE} = 5.0V, R_G = 2.0 kΩ, f = 1.0 kHz, BW = 200 Hz
21. I_C = 20μA, V_{CE} = 5.0V, R_S = 10 kΩ,
    a – f = 1.0 kHz, BW = 200 Hz
    b – f = 10 kHz, BW = 2.0 kHz
    c – BW = 15.7 kHz
22. I_C = 500 mA, V_{CC} = 25V, I_{B1} = 50 mA, I_{B2} = 25 mA

*Electrically but not identical to pro-electron type numbers.

Pro-Electron Series

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) @ V_{CB} (V) Max	h_{FE} h_{fe} (1kHz)* Min	Max	@ I_C (mA)	V_{CE} (V)	$V_{CE(sat)}$ (V) Max	$V_{BE(sat)}$ $V_{BE(on)}$* (V) Min	Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
BC178	TO-18	30	25	5	100 @ 20	75	500*	2	5		0.6	0.75*	2	6					10	1	71
			BV_{CES} 30		I_{CES}					V_{CEK} 0.6			10							
BC178A	TO-18	30	25	5	100 @ 20						0.6	0.75*	2	6					10	1	71
			BV_{CES} 30		I_{CES}					V_{CEK} 0.6											
BC178B	TO-18	30	25	5	100 @ 20						0.6	0.75*	2	6					10	1	71
			BV_{CES} 30		I_{CES}					V_{CEK} 0.6											
BC179	TO-18	25	20	5	100 @ 20						0.6	0.75*	2	6					4	1	71
			BV_{CES} 25		I_{CES}					V_{CEK} 0.6									4	5	
BC179A	TO-18	25	20	5	100 @ 20						0.6	0.75*	2	6					4	1	71
			BV_{CES} 30		I_{CES}					V_{CEK} 0.6									4	5	
BC179B	TO-18	25	20	5	100 @ 20						0.6	0.75*	2	6					4	1	71
					I_{CES}					V_{CEK}									4	5	
BC182K	TO-106	60	50	5	15 @ 50	40		0.01	5	0.25			10	5	150		10		10	1	04
						100	480	2	5	0.6		1.2	100								
						80		100	5		0.55	0.7*	2								
BC182KA	TO-106	60	50	5	15 @ 50	40		0.01	5	0.25			10	5	150		10		10	1	04
						100		2	5	0.6		1.2	100								
						80		100	5		0.55	0.7*	2								
BC182KB	TO-106	60	50	5	15 @ 50	40		0.01	5	0.25			10	5	150		10		10	1	04
						100		2	5	0.6		1.2	100								
						80		100	5		0.55	0.7*	2								
BC182L	TO-92(74)	60	50	5	15 @ 50	40		0.01	5	0.25			10	5	150		10		10	1	04
						80		100	5	0.6		1.2	100								
						125	500*	2	5		0.55	0.7*	2								
BC182LA	TO-92(74)	60	50	5	15 @ 50	40		0.01	5	0.25			10		150		10		10	1	04
						80		100	5	0.6		1.2	100								
						125	260*	2	5		0.55	0.7*	2								
BC182LB	TO-92(74)	60	50	5	15 @ 50	40		0.01	5	0.25			10	5	150		10		10	1	04
						80		100	5	0.6		1.2	100								
						240	500*	2	5		0.55	0.7*	2								
BC183K	TO-106	45	30	5	15 @ 30	40		0.01	5	0.25			10	5	150		10		10	1	04
						125	900*	2	5	0.6		1.2	100								
						80		100	5		0.55	0.7*	2								
BC183KA	TO-106	45	30	5	15 @ 30	40		0.01	5	0.25			10	5	150		10		10	1	04
						125	260*	2	5	0.6		1.2	100								
						80		100	5		0.55	0.7*	2								
BC183KB	TO-106	45	30	5	15 @ 30	40		0.01	5	0.25			10	5	150		10		10	1	04
						240	500*	2	5	0.6		1.2	100								
						80		100	5		0.55	0.7*	2								
BC183KC	TO-106	45	30	5	15 @ 30	40		0.01	5	0.25			10	5	150		10		10	1	04
						450	900*	2	5	0.6		1.2	100								
						80		100	5		0.55	0.7*	2								
BC183L	TO-92(74)	45	30	5	15 @ 30	40		0.01	5	0.25			10	5	150		10		10	1	04
						80		100	5	0.6		1.2	100								
						125	900*	2	5		0.55	0.7*	2								

BC183LA	TO-92(74)	45	30	5	15	30	40		0.01	5	0.25			10	5	150	10		10	1	04
							80		100	5	0.6		1.2	100								
							125	260*	2	5		0.55	0.7*	2								
BC183LB	TO-92(74)	45	30	5	15	30	40		0.01	5	0.25			10	5	150	10		10	1	04
							80		100	5	0.6		1.2	100								
							240	500*	2	5		0.55	0.7*	2								
BC183LC	TO-92(74)	45	30	5	15	30	40		0.01	5	0.25			10	5	150	10		10	1	04
							80		100	5	0.6		1.2	100								
							450	900*	2	5		0.55	0.7*	2								
BC184K	TO-106	45	30	5	15	30	100		0.01	5	0.25			10	5	150	10		4	2	04
							240	900*	2	5	0.6		1.2	100								
							130		100	5		0.55	0.7*	2								
BC184KB	TO-106	45	30	5	15	30	100		0.01	5	0.25			10	5	150	10		4	2	04
							240	500*	2	5	0.6		1.2	100								
							130		100	5		0.55	0.7*	2								
BC184KC	TO-106	45	30	5	15	30	100		0.01	5	0.25			10	5	150	10		4	2	04
							450	900*	2	5	0.6		1.2	100								
							130		100	5		0.55	0.7*	2								
BC184L	TO-92(74)	45	30	5	15	30	100		0.01	5	0.25			10	5	150	10		4	2	04
							130		100	5	0.6		1.2	100								
							240	900*	2	5		0.55	0.7*	2								
BC184LB	TO-92(74)	45	30	5	15	30	100		0.01	5	0.25			10	5	150	10		4	2	04
							130		100	5	0.6		1.2	100								
							240	500*	2	5		0.55	0.7*	2								
BC184LC	TO-92(74)	45	30	5	15	30	100		0.01	5	0.25			10	5	150	10		4	2	04
							130		100	5	0.6		1.2	100								
							450	900*	2	5		0.55	0.7*	2								
BC204	TO-106	50	45	5	50	45	50	450	2	5	0.3			10					10	1	71
												0.55	0.75*	2								
BC204A	TO-106	50	45	5	50	45	110	220	2	5	0.3			10					10	1	71
												0.55	0.75*	2								
BC204B	TO-106	50	45	5	50	45	200	450	2	5	0.3			10					10	1	62
												0.55	0.75*	2								
BC204VI	TO-106	50	45	5	50	45	50	120	2	5	0.3			10					10	1	71
												0.55	0.75*	2								
BC205	TO-106	25	20	5	50	20	110	450	2	5	0.3			10					10	1	71
												0.55	0.75*	2								
BC205A	TO-106	25	20	5	50	20	110	200	2	5	0.3			10					10	1	71
												0.55	0.75*	2								
BC205B	TO-106	25	20	5	50	20	200	450	2	5	0.3			10					10	1	62
												0.55	0.75*	2								
BC206	TO-106	25	25	5	50	20	200		2	5	0.3			10					4	1	62
												0.55	0.75*	2								

Test Conditions

1. I_C = 200μA, V_{CE} = 5.0V, R_S = 2.0 kΩ, f = 1.0 kHz, BW = 200 Hz
2. I_C = 200μA, V_{CE} = 5.0V, R_S = 2.0 kΩ, W.B.
3. I_C = 30μA, V_{CE} = 5.0V, R_S = 10 kΩ, f = 1.0 kHz, BW = 200 Hz
4. I_C = 20μA, V_{CE} = 5.0V, R_S = 10 kΩ, f = 1.0 kHz, BW = 150 Hz
5. I_C = 200μA, V_{CE} = 5.0V, R_G = 2.0 kΩ, f = 20 Hz to 15 kHz
6. I_C = 100μA, V_{CE} = 5.0V, R_S = 2.0 kΩ, f = 10 Hz to 10 kHz
7. I_C = 50μA, V_{CE} = 5.0V, R_S = 10 kΩ, BW = 10 Hz to 15 kHz
8. I_C = 50μA, V_{CE} = 5.0V, R_S = 10 kΩ, f = 1.0 kHz, BW = 200 Hz
9. I_C = 200μA, V_{CE} = 2.0V, R_S = 2.0 kΩ, f = 1.0 kHz, BW = 200 Hz
10. I_C = 10μA, V_{CE} = 5.0V, R_S = 10 kΩ, W.B.
11. I_C = 150 mA, V_{CE} = 10V, I_{B1} = I_{B2} = 15 mA
12. I_C = 150 mA, I_{B1} = I_{B2} = ±7.5 mA
13. I_C = 10 mA, I_{B1} = 3.0 mA, I_{B2} = 1.0 mA
14. I_C = 100 mA, I_{B1} = 40 mA, I_{B2} = 20 mA
15. V_{CC} = 10V, I_C = 100 mA I_{B1} = I_{B2} = 10 mA
16. I_C = 150 mA, V_{CE} = 6.0V, I_{B1} = I_{B2} = 15 mA
17. I_C = 10 mA, I_{B1} = 1.0 mA, I_{B2} = −1.0 mA
18. I_C = 300 mA, V_{CC} = 25V, I_{B1} = I_{B2} = 30 mA
19. V_{CC} = 20V, I_C = 100 mA I_{B1} = I_{B2} = 5.0 mA
20. I_C = 1.0 mA, V_{CE} = 5.0V, R_G = 2.0 kΩ, f = 1.0 kHz, BW = 200 Hz
21. I_C = 20μA, V_{CE} = 5.0V, R_S = 10 kΩ,
    a – f = 1.0 kHz, BW = 200 Hz
    b – f = 10 kHz, BW = 2.0 kHz
    c – BW = 15.7 kHz
22. I_C = 500 mA, V_{CC} = 25V, I_{B1} = 50 mA, I_{B2} = 25 mA

*Electrically but not identical to pro-electron type numbers.

Pro-Electron Series

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} h_{fe} (1kHz)* Min	Max	@ I_C (mA)	V_{CE} (V)	$V_{CE(sat)}$ (V) Max	$V_{BE(sat)}$ $V_{BE(on)}$* (V) Min	Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
BC206B	TO-106	25	25	5	50	20	200	450	2	5	0.3			10						4	1	62
												0.55	0.75*	2								
BC207	TO-106	50	45	5	15	40	110	450	2	5	0.25			10	6					10	1	04
											0.6			100								
BC207A	TO-106	50	45	5	15	40	110	220	2	5	0.25			10	6					10	1	04
											0.6			100								
BC207B	TO-106	50	45	5	15	40	200	450	2	5	0.25			10	6					10	1	04
							40		0.10	5	0.6			100								
BC208	TO-106	25	20	5	15	20	110	800	2	5	0.25			10	6					10	1	04
											0.6			100								
BC208A	TO-106	25	20	5	15	20	110	220	2	5	0.25			10	6					10	1	04
											0.6			100								
BC208B	TO-106	25	20	5	15	20	200	450	2	5	0.25			10	6					10	1	04
							40		0.10	5	0.6			100								
BC208C	TO-106	25	20	5	15	20	420	800	2	5	0.25			10	6					10	1	04
							100		0.10	5	0.6			100								
BC209	TO-106	25	20	5	15	20	200	800	2	5	0.25			10	6					4	2	04
							70	0.10	0.10	5	0.6			100								
BC209B	TO-106	25	20	5	15	20	200	450	2	5	0.25			10	6					4	2	04
							40		0.10	5	0.6			100								
BC209C	TO-106	25	20	5	15	20	420	800	2	5	0.25			10	6					4	2	04
							100		0.10	5	0.6			100								
BC212L	TO-92(74)	60	50	5	15	30	40		0.01	5	0.6		1.1	100	10	200		10		10	1	63
							60	300	2	5	0.25			10								
												0.6	0.72*	2								
BC212LA	TO-92(74)	60	50	5	15	30	40		0.01	5	0.6		1.1	100	10	200		10		10	1	63
							60	300	2	5	0.25			10								
							100	300*	2	5		0.6	0.72*	2								
BC212LB	TO-92(74)	60	50	5	15	30	200	400*	2	5	0.6		1.1	100	10	200		10		10	1	63
											0.25			10								
												0.6	0.72*	2								
BC212K	TO-106	60	50	5	15	30	40		0.01	5		0.6	0.72*	2	10	200		10		10	1	63
							60	300	2	5	0.25			10								
							60	*	2	5	0.6		1.1	100								
BC212KA	TO-106	60	50	5	15	30	40		0.01	5					10	200		10		10	1	63
							60	300	2	5		0.6	0.72*	2								
							100	300*	2	5	0.25			10								
											0.6		1.1	100								
BC212KB	TO-106	60	50	5	15	30	40		0.01	5		0.6	0.72*	2	10	200		10		10	1	63
							60	300	2	5	0.25			10								
							200	400*	2	5	0.6			100								
BC213K	TO-106	45	30	5	15	30	40		0.01	5		0.6	0.72*	2	10	200		10		10	1	63
							80	400	2	5	0.25			10								
							80	*	2	5	0.6		1.1	100								
BC213KA	TO-106	45	30	5	15	30	40		0.01	5		0.6	0.72*	2	10	200		10		10	1	63
							80		2	5	0.25			10								
							100	300*	2	5	0.6		1.1	100								
BC213KB	TO-106	45	30	5	15	30	40		0.01	5		0.6	0.72*	2	10	200		10		10	1	63
							80		2	5	0.25			10								
							200	400*	2	5	0.6		1.1	100								

BC213KC	TO-106	45	30	5	15	30	40		0.01	5		0.6	0.72*	2	10	200	10		10	1	63
							80		2	5	0.25			10							
							350	600*	2	5	0.6		1.1	100							
BC213L	TO-92(74)	45	30	5	15	30	40		0.01	5	0.25			10	10	200	10		10	1	63
							80	400	2	5	0.6		1.1	100							
												0.6	0.72*	2							
BC213LA	TO-92(74)	45	30	5	15	30	40		0.01	5	0.25			10	10	200	10		10	1	63
							100	300*	2	5	0.6		1.1	100							
												0.6	0.72*	2							
BC213LB	TO-92(74)	45	30	5	15	30	40		0.01	5	0.25			10	10	200	10		10	1	63
							200	400*	2	5	0.6		1.1	100							
												0.6	0.72*	2							
BC213LC	TO-92(74)	45	30	5	15	30	350	600*	2	5	0.25			10	10	200	10		10	1	63
											0.6		1.1	100							
												0.6	0.72*	2							
BC214K	TO-106	45	30	5	15	30	100		0.01	5		0.6	0.72*	2	10	200	10		2	2	63
							140	400	2	5	0.25			10							
							120		100	5	0.6		1.1	100							
BC214KA	TO-106	45	30	5	15	30	100		0.01	5		0.6	0.72*	2	10	200	10		2	2	63
							140	400	2	5	0.25			10							
							120		100	5	0.6		1.1	100							
							100	300*	2	5											
BC214KB	TO-106	45	30	5	15	30	100		0.01	5		0.6	0.72*	2	10	200	10		2	2	63
							200	400*	2	5	0.25			10							
							120		100	5	0.6		1.1	100							
BC214KC	TO-106	45	30	5	15	30	100		0.01	5		0.6	0.72*	2	10	200	10		2	2	63
							350	600*	2	5	0.25			10							
							120		100	5	0.6		1.1	100							
BC214L	TO-92(74)	45	30	5	15	30	100		0.01	5	0.25			10	10	200	10		2	2	63
							140	400	2	5	0.6		1.1	100							
							120		100	5		0.6	0.72*	2							
BC214LB	TO-92(74)	45	30	5	15	30	200	400*	2	5	0.25			10	10	200	10		2	2	63
											0.6		1.1	100							
												0.6	0.72*	2							
BC214LC	TO-92(74)	45	30	5	15	30	350	600*	2	5	0.25			10	10	200	10		2	2	63
											0.6		1.1	100							
												0.6	0.72*	2							
BC237	TO-106	50	45	6	50	20	125	500*	2	5	0.25		0.77*	10	4.5				10	1	04
											0.6			100							
BC237A	TO-106	50	45	6	50	20	125	260*	2	5	0.25		0.77*	10	4.5				10	1	04
											0.6			100							
BC237B	TO-106	50	45	6	50	20	240	500*	2	5	0.25		0.77*	10	4.5				10	1	04
											0.6			100							
BC238	TO-106	30	20	5	50	20	125	900*	2	5	0.25		0.77*	10	4.5				10	1	04
											0.6			100							

Test Conditions

1. I_C = 200μA, V_{CE} = 5.0V, R_S = 2.0 kΩ, f = 1.0 kHz, BW = 200 Hz
2. I_C = 200μA, V_{CE} = 5.0V, R_S = 2.0 kΩ, W.B.
3. I_C = 30μA, V_{CE} = 5.0V, R_S = 10 kΩ, f = 1.0 kHz, BW = 200 Hz
4. I_C = 20μA, V_{CE} = 5.0V, R_S = 10 kΩ, f = 1.0 kHz, BW = 150 Hz
5. I_C = 200μA, V_{CE} = 5.0V, R_G = 2.0 kΩ, f = 20 Hz to 15 kHz
6. I_C = 100μA, V_{CE} = 5.0V, R_S = 2.0 kΩ, f = 10 Hz to 10 kHz
7. I_C = 50μA, V_{CE} = 5.0V, R_S = 10 kΩ, BW = 10 Hz to 15 kHz
8. I_C = 50μA, V_{CE} = 5.0V, R_S = 10 kΩ, f = 1.0 kHz, BW = 200 Hz
9. I_C = 200μA, V_{CE} = 2.0V, R_S = 2.0 kΩ, f = 1.0 kHz, BW = 200 Hz
10. I_C = 10μA, V_{CE} = 5.0V, R_S = 10 kΩ, W.B.
11. I_C = 150 mA, V_{CE} = 10V, $I_{B1} = I_{B2}$ = 15 mA
12. I_C = 150 mA, $I_{B1} = I_{B2}$ = ±7.5 mA
13. I_C = 10 mA, I_{B1} = 3.0 mA, I_{B2} = 1.0 mA
14. I_C = 100 mA, I_{B1} = 40 mA, I_{B2} = 20 mA
15. V_{CC} = 10V, I_C = 100 mA $I_{B1} = I_{B2}$ = 10 mA
16. I_C = 150 mA, V_{CE} = 6.0V, $I_{B1} = I_{B2}$ = 15 mA
17. I_C = 10 mA, I_{B1} = 1.0 mA, I_{B2} = −1.0 mA
18. I_C = 300 mA, V_{CC} = 25V, $I_{B1} = I_{B2}$ = 30 mA
19. V_{CC} = 20V, I_C = 100 mA $I_{B1} = I_{B2}$ = 5.0 mA
20. I_C = 1.0 mA, V_{CE} = 5.0V, R_G = 2.0 kΩ, f = 1.0 kHz, BW = 200 Hz
21. I_C = 20μA, V_{CE} = 5.0V, R_S = 10 kΩ,
    a — f = 1.0 kHz, BW = 200 Hz
    b — f = 10 kHz, BW = 2.0 kHz
    c — BW = 15.7 kHz
22. I_C = 500 mA, V_{CC} = 25V, I_{B1} = 50 mA, I_{B2} = 25 mA

*Electrically but not identical to pro-electron type numbers.

Pro-Electron Series

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) @ V_{CB} (V) Max	h_{FE} h_{fe} (1kHz)* Min	Max	@ I_C (mA)	V_{CE} (V)	$V_{CE(sat)}$ (V) Max	$V_{BE(sat)}$ $V_{BE(on)}$* (V) Min	Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) @ I_C (mA) Min	Max	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
BC238A	TO-106	30	20	5	50 @ 20	125	260*	2	5	0.25 0.6		0.77*	10 100	4.5				10	1	04
BC238B	TO-106	30	20	5	50 @ 20	240	500*	2	5	0.25 0.6		0.77*	10 100	4.5				10	1	04
BC238C	TO-106	30	20	5	50 @ 20	450	900*	2	5	0.25 0.6		0.77*	10 100	4.5				10	1	04
BC239	TO-106	30	20	5	50 @ 20	240	900*	2	5	0.25		0.7*	10 2	4.5				4 4	1 2	04
BC239B	TO-106	30	20	5	50 @ 20	240	500*	2	5	0.25		0.7*	10 2	4.5				4 4	1 2	04
BC239C	TO-106	30	20	5	50 @ 20	450	900*	2	5	0.25		0.7*	10 2	4.5				4 4	1 2	04
BC251A	TO-106		45	5	50 @ 45	125	260*	2	5	0.25 0.6		0.9	10 100					6	1	71
BC251B	TO-106		45	5	50 @ 45	240	500*	2	5	0.25 0.6		0.9	10 100					6	1	71
BC251CA	TO-106		45	5	50 @ 45	450	900*	2	5	0.25		0.9	10					6	1	62
BC252A	TO-106		20	5	50 @ 20	125	260*	2	5	0.25 0.6		0.9	10 100					6	1	71
BC252B	TO-106		20	5	50 @ 20	240	500*	2	5	0.25 0.6		0.9	10 100					6	1	71
BC252CA	TO-106		20	5	50 @ 20	450	900*	2	5	0.25		0.9	10					6	1	62
BC253A	TO-106		20	5	50 @ 20	40 125	260*	0.01 2	5 5	0.25 0.6		0.9 0.9	10 100					2.5	2	71
BC253B	TO-106		20	5	50 @ 20	40 240	500*	0.01 2	5 5	0.25 0.6		0.9	10 100					2.5	2	71
BC253CA	TO-106		20	5	50 @ 20	100 450	900*	0.01 2	5 5	0.25		0.9	10					2.5	2	62
BC261A	TO-18		45		50 @ 45	125	260*	2	5	0.25 0.6		0.9	10 100					6	9	71
BC261B	TO-18		45		50 @ 45	240	500*	2	5	0.25 0.6		0.9	10 100					6	9	71
BC262A	TO-18		20	5	50 @ 20	125	260*	2	5	0.25 0.6		0.9	10 100					6	9	71
BC262B	TO-18		20	5	50 @ 20	240	500*	2	5	0.25 0.6		0.9	10 100					6	9	71
BC263A	TO-18		20	5	50 @ 20	40 125	260*	0.01 2	5 5	0.25 0.6		0.9	10 100					2.5	2	71
BC263B	TO-18		20	5	50 @ 20	40 240	500*	0.01 2	5 5	0.25 0.6		0.9	10 100					2.5	2	71
BC307	TO-106	50	45	5	100 @ 20 I_{CES}	75	50*	2	5	0.6 V_{CEK}	0.6	0.75*	10 2	6				10	1	71
BC307A	TO-106	50	45	5	100 @ 20 I_{CES}	125	160*	2	5	0.6 V_{CEK}	0.6	0.75*	10 2	6				10	1	71
BC307B	TO-106	50	45	5	100 @ 20 I_{CES}	240	500*	2	5	0.6 V_{CEK}	0.6	0.75*	10 2	6				10	1	71

BC307VI	TO-106	50	45	5	100	20	75	150*	2	5	0.6			10	6				10	1	71
					I_{CES}						V_{CEK}	0.6	0.75*	2							
BC308	TO-106	30	25	5	50	20	125	500*	2	5	0.6			10	6				10	1	71
											V_{CEK}	0.6	0.75*	2							
BC308A	TO-106	30	25	5	50	20	125	260*	2	5	0.6			10	6				10	1	71
											V_{CEK}	0.6	0.75*	2							
BC308B	TO-106	30	25	5	50	20	240	500*	2	5	0.6			10	6				10	1	71
											V_{CEK}	0.6	0.75*	2							
BC308C	TO-106	30	25	5	100	20	450	900*	2	5	0.18		0.78	10	6				10	1	71
													0.75*	2							
													1*	100							
BC309	TO-106	25	20	5	100	20	125	900*	2	5	0.18		0.78	10	6				4	1	71
													0.75*	2					4	2	
													1*	100							
BC309A	TO-106	25	20	5	100	20	125	260*	2	5	0.18		0.78	10	6				4	1	71
													0.75*	2					4	2	
													1*	100							
BC309B	TO-106	25	20	5	100	20	240	500*	2	5	0.18		0.78	10	6				4	1	71
													0.75*	2					4	2	
													1*	100							
BC309C	TO-106	25	20	5	100	20	450	900*	2	5	0.18		0.78	10	6				4	1	71
													0.75*	2					4	2	
													1*	100							
BC317	TO-92(72)	50	45	6	30	20	110	450	2	5		0.57	0.72*	2	4				6	1	04
							125	500*	2	5	0.2		0.77*	10							
											0.5			100							
BC317A	TO-92(72)	50	45	6	30	20	110	220	2	5		0.57	0.72*	2	4				6	1	04
							125	260*	2	5	0.2		0.77*	10							
											0.5			100							
BC317B	TO-92(72)	50	45	6	30	20	200	450	2	5		0.57	0.72*	2	4				6	1	04
							240	500*	2	5	0.2		0.77*	10							
											0.5			100							
BC318	TO-92(72)	30	20	5	30	20	110	800	2	5		0.57	0.72*	2	4				6	1	04
							125	900*	2	5	0.2		0.77*	10							
											0.5			100							
BC318A	TO-92(72)	30	20	5	30	20	110	220	2	5		0.57	0.72*	2	4				6	1	04
							125	260*	2	5	0.2		0.77*	10							
											0.5			100							
BC318B	TO-92(72)	30	20	5	30	20	200	450	2	5		0.57	0.72*	2	4				6	1	04
							240	500*	2	5	0.2		0.77*	10							
							40		0.01	5	0.5			100							
BC318C	TO-92(72)	30	20	5	30	20	420	800	2	5		0.57	0.72*	2	4				6	1	04
							450	900*	2	5	0.2		0.77*	10							
							100		0.01	5	0.5			100							

Test Conditions

1. I_C = 200μA, V_{CE} = 5.0V, R_S = 2.0 kΩ, f = 1.0 kHz, BW = 200 Hz
2. I_C = 200μA, V_{CE} = 5.0V, R_S = 2.0 kΩ, W.B.
3. I_C = 30μA, V_{CE} = 5.0V, R_S = 10 kΩ, f = 1.0 kHz, BW = 200 Hz
4. I_C = 20μA, V_{CE} = 5.0V, R_S = 10 kΩ, f = 1.0 kHz, BW = 150 Hz
5. I_C = 200μA, V_{CE} = 5.0V, R_G = 2.0 kΩ, f = 20 Hz to 15 kHz
6. I_C = 100μA, V_{CE} = 5.0V, R_S = 2.0 kΩ, f = 10 Hz to 10 kHz
7. I_C = 50μA, V_{CE} = 5.0V, R_S = 10 kΩ, BW = 10 Hz to 15 kHz
8. I_C = 50μA, V_{CE} = 5.0V, R_S = 10 kΩ, f = 1.0 kHz, BW = 200 Hz
9. I_C = 200μA, V_{CE} = 2.0V, R_S = 2.0 kΩ, f = 1.0 kHz, BW = 200 Hz
10. I_C = 10μA, V_{CE} = 5.0V, R_S = 10 kΩ, W.B.
11. I_C = 150 mA, V_{CE} = 10V, I_{B1} = I_{B2} = 15 mA
12. I_C = 150 mA, I_{B1} = I_{B2} = ±7.5 mA
13. I_C = 10 mA, I_{B1} = 3.0 mA, I_{B2} = 1.0 mA
14. I_C = 100 mA, I_{B1} = 40 mA, I_{B2} = 20 mA
15. V_{CC} = 10V, I_C = 100 mA I_{B1} = I_{B2} = 10 mA
16. I_C = 150 mA, V_{CE} = 6.0V, I_{B1} = I_{B2} = 15 mA
17. I_C = 10 mA, I_{B1} = 1.0 mA, I_{B2} = −1.0 mA
18. I_C = 300 mA, V_{CC} = 25V, I_{B1} = I_{B2} = 30 mA
19. V_{CC} = 20V, I_C = 100 mA I_{B1} = I_{B2} = 5.0 mA
20. I_C = 1.0 mA, V_{CE} = 5.0V, R_G = 2.0 kΩ, f = 1.0 kHz, BW = 200 Hz
21. I_C = 20μA, V_{CE} = 5.0V, R_S = 10 kΩ,
    a – f = 1.0 kHz, BW = 200 Hz
    b – f = 10 kHz, BW = 2.0 kHz
    c – BW = 15.7 kHz
22. I_C = 500 mA, V_{CC} = 25V, I_{B1} = 50 mA, I_{B2} = 25 mA

*Electrically but not identical to pro-electron type numbers.

Pro-Electron Series

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) @ V_{CB} (V) Max	h_{FE} h_{fe} (1kHz)* Min	Max	@ I_C (mA)	V_{CE} (V)	$V_{CE(sat)}$ (V) Max	$V_{BE(sat)}$ $V_{BE(on)}$* (V) Min	Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
BC319	TO-92(72)	30	20	5	30 @ 20	200	800	2	5		0.57	0.72*	2	4					4	1	04
						240	900*	2	5	0.2		0.77	10						4	2	
						40		0.01	5	0.5			100								
BC319B	TO-92(72)	30	20	5	30 @ 20	200	450	2	5		0.57	0.72*	2	4					4	1	04
						240	500*	2	5	0.2		0.77*	10						4	2	
						40		0.01	5	0.5			100								
BC319C	TO-92(72)	30	20	5	30 @ 20	420	800	2	5		0.57	0.72*	2	4					4	1	04
						450	900*	2	5	0.2		0.77*	10						4	2	
						100		0.01	5	0.5			100								
BC327	TO-92(77)	50 BV_{CES}	45	5	100 @ 45 I_{CES}	100	600	100	1	0.7			500								67
						40		300	1			1.2*	300								
BC328	TO-92(77)	30 BV_{CES}	25	5	100 @ 25 I_{CES}	100	600	100	1	0.7			500								67
						40		300	1			1.2*	300								
BC337	TO-92(77)	50 BV_{CES}	45	5	100 @ 45 I_{CES}	100	600	100	1	0.7			500								14
						40		300	1			1.2*	300								
BC338	TO-92(77)	30 BV_{CES}	25	5	100 @ 25 I_{CES}	100	600	100	1	0.7			500								14
						40		300	1			1.2*	300								
BC407	TO-106	50	45	6	50 @ 20	125	500*	2	5	0.25		0.77*	10	4.5					10	1	04
										0.6			100								
											0.55	0.7*	2								
BC407A	TO-106	50	45	6	50 @ 20	125	260*	2	5	0.25		0.77*	10	4.5					10	1	04
										0.6			100								
											0.55	0.7*	2								
BC407B	TO-106	50	45	6	50 @ 20	240	500*	2	5	0.25		0.77*	10	4.5					10	1	04
										0.6			100								
											0.55	0.7*	2								
BC408	TO-106	30	20	5	50 @ 20	125	900*	2	5	0.25		0.77*	10	4.5					10	1	04
										0.6			100								
											0.55	0.7*	2								
BC408A	TO-106	30	20	5	50 @ 20	125	260*	2	5	0.25		0.77*	10	4.5					10	1	04
										0.6			100								
											0.55	0.7*	2								
BC408B	TO-106	30	20	5	50 @ 20	240	500*	2	5	0.25		0.77*	10	4.5					10	1	04
										0.6			100								
											0.55	0.7*	2								
BC408C	TO-106	30	20	5	50 @ 20	450	900*	2	5	0.25		0.77*	10	4.5					10	1	04
										0.6			100								
											0.55	0.7*	2								
BC409	TO-106	30	20	5	50 @ 20	240	900*	2	5	0.25		0.77*	10	4.5					4	1	04
										0.6			100						4	2	
											0.55	0.7*	2								
BC409B	TO-106	30	20	5	50 @ 20	240	500*	2	5	0.25			10	4.5					4	1	04
										0.6			100						4	2	
											0.55	0.7*	2								
BC409C	TO-106	30	20	5	50 @ 20	450	900*	2	5	0.25		0.77*	10	4.5					4	1	04
										0.6			100						4	2	
											0.55	0.7*	2								
BC413	TO-106	45	30	5	15 @ 30	200	800	2	5	0.25			10						3	2	04
										0.6			100								
											0.55	0.7*	2								

BC413B	TO-106	45	30	5	15	30	200	450	2	5	0.25			10							3	2	04
											0.6			100									
												0.55	0.7*	2									
BC413C	TO-106	45	30	5	15	30	420	800	2	5	0.25			10							3	2	04
											0.6			100									
												0.55	0.7*	2									
BC414	TO-106	50	45	5	15	30	180	800	2	5		0.55	0.7*	2							3	2	04
							240	900*	2	5	0.25			10									
											0.6			100									
BC414B	TO-106	50	45	5	15	30	180	460	2	5		0.55	0.7*	2							3	2	04
							240	500*	2	5	0.25			10									
											0.6			100									
BC414C	TO-106	50	45	5	15	30	380	800	2	5		0.55	0.7*	2							3	2	04
							450	900*	2	5	0.25			10									
											0.6			100									
BCY56	TO-18	45	45	5	100	20	40		0.01	5		0.6	0.7*	2							5	2	04
							100	450	2	5													
							100		10	5													
							125	500*	2	5													
BCY57	TO-18	25	20	5	100	20	100		0.01	5		0.6	0.7*	2							5	2	04
							200	800	2	5													
							200		10	5													
							240	900*	2	5													
BCY58	TO-18	32	32	7	10	32	120	630	2	5	0.35	0.6	0.85	10	6	125	10	800			17	04
						I_{CES}	80	1000	10	1	0.7	0.75	1.2	100				800			15	
							40		100	1		0.55	0.7*	2					6		1	
BCY58-7	TO-18	32	32	7	10	32	120	220	2	5	0.35	0.6	0.85	10	6	125	10	800			17	04
						I_{CES}	80		10	1	0.7	0.75	1.2	100				800			15	
							40		100	1		0.55	0.7*	2					6		1	
BCY58-8	TO-18	32	32	7	10	32	20		0.01	5	0.35	0.6	0.85	10	6	125	10	800			17	04
						I_{CES}	180	310	2	5	0.7	0.75	1.2	100				800			15	
							120	400	10	1		0.55	0.7*	2					6		1	
							45		100	1													
BCY58-9	TO-18	32	32	7	10	32	40		0.01	5	0.35	0.6	0.85	10	6	125	10	800			17	04
						I_{CES}	250	460	2	5	0.7	0.75	1.2	100				800			15	
							160	630	10	1		0.55	0.7*	2					6		1	
							60		100	1													
BCY58-10	TO-18	32	32	7	10	32	100		0.01	5	0.35	0.6	0.85	10	6	125	10	800			17	04
						I_{CES}	380	630	2	5	0.7	0.75	1.2	100				800			15	
							240	1000	10	1		0.55	0.7*	2					6		1	
							60		100	1													
BCY59	TO-18	45	45	7	10	45	120	630	2	5	0.35	0.6	0.85	10	6	125	10	800			17	04
						I_{CES}	80	1000	10	1	0.7	0.75	1.2	100				800			15	
							40		100	1		0.55	0.7*	2					6		1	

Test Conditions

1. I_C = 200μA, V_{CE} = 5.0V, R_S = 2.0 kΩ, f = 1.0 kHz, BW = 200 Hz
2. I_C = 200μA, V_{CE} = 5.0V, R_S = 2.0 kΩ, W.B.
3. I_C = 30μA, V_{CE} = 5.0V, R_S = 10 kΩ, f = 1.0 kHz, BW = 200 Hz
4. I_C = 20μA, V_{CE} = 5.0V, R_S = 10 kΩ, f = 1.0 kHz, BW = 150 Hz
5. I_C = 200μA, V_{CE} = 5.0V, R_G = 2.0 kΩ, f = 20 Hz to 15 kHz
6. I_C = 100μA, V_{CE} = 5.0V, R_S = 2.0 kΩ, f = 10 Hz to 10 kHz
7. I_C = 50μA, V_{CE} = 5.0V, R_S = 10 kΩ, BW = 10 Hz to 15 kHz
8. I_C = 50μA, V_{CE} = 5.0V, R_S = 10 kΩ, f = 1.0 kHz, BW = 200 Hz
9. I_C = 200μA, V_{CE} = 2.0V, R_S = 2.0 kΩ, f = 1.0 kHz, BW = 200 Hz
10. I_C = 10μA, V_{CE} = 5.0V, R_S = 10 kΩ, W.B.
11. I_C = 150 mA, V_{CE} = 10V, I_{B1} = I_{B2} = 15 mA
12. I_C = 150 mA, I_{B1} = I_{B2} = ±7.5 mA
13. I_C = 10 mA, I_{B1} = 3.0 mA, I_{B2} = 1.0 mA
14. I_C = 100 mA, I_{B1} = 40 mA, I_{B2} = 20 mA
15. V_{CC} = 10V, I_C = 100 mA I_{B1} = I_{B2} = 10 mA
16. I_C = 150 mA, V_{CE} = 6.0V, I_{B1} = I_{B2} = 15 mA
17. I_C = 10 mA, I_{B1} = 1.0 mA, I_{B2} = −1.0 mA
18. I_C = 300 mA, V_{CC} = 25V, I_{B1} = I_{B2} = 30 mA
19. V_{CC} = 20V, I_C = 100 mA I_{B1} = I_{B2} = 5.0 mA
20. I_C = 1.0 mA, V_{CE} = 5.0V, R_G = 2.0 kΩ, f = 1.0 kHz, BW = 200 Hz
21. I_C = 20μA, V_{CE} = 5.0V, R_S = 10 kΩ,
    a — f = 1.0 kHz, BW = 200 Hz
    b — f = 10 kHz, BW = 2.0 kHz
    c — BW = 15.7 kHz
22. I_C = 500 mA, V_{CC} = 25V, I_{B1} = 50 mA, I_{B2} = 25 mA

*Electrically but not identical to pro-electron type numbers.

Pro-Electron Series

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} h_{fe} (1kHz)* Min	Max	@ I_C (mA)	V_{CE} (V)	$V_{CE(sat)}$ (V) Max	$V_{BE(sat)}$ $V_{BE(on)}$* (V) Min	Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
BCY59-7	TO-18	45	45	7	10	45	120	220	2	5	0.35	0.6	0.85	10	6	125		10	800		17	04
					I_{CES}		80		10	1	0.7	0.75	1.2	100					800		15	
							40		100	1		0.55	0.7*	2						6	1	
BCY59-8	TO-18	45	45	7	10	45	20		0.01	5	0.35	0.6	0.85	10	6	125		10	800		17	04
					I_{CES}		180	310	2	5	0.7	0.75	1.2	100					800		15	
							120	400	10	1		0.55	0.7*	2						6	1	
BCY59-9	TO-18	45	45	7	10	59 45	40		0.01	5	0.35	0.6	0.85	10	6	125		10	800		17	04
					I_{CES}		250	460	2	5	0.7	0.75	1.2	100					800		15	
							160	630	10	1		0.55	0.7*	2						6	1	
							60		100	1												
BCY59-10	TO-18	45	45	7	10	45	100		0.01	5	0.35	0.6	0.85	10	6	125		10	800		17	04
					I_{CES}		380	630	2	5	0.7	0.75	1.2	100					800		15	
							240	1000	10	1		0.55	0.7*	2						6	1	
							60		100	1												
BCY70	TO-18	50	40	5	10	50	40		0.1	1	0.25	0.6	0.9	10	6	250		10		6	6	71
							45		1	1	0.5		1.2	50					420		17	
							50		10	1												
							15		50	1												
BCY71	TO-18	45	45	5	500	45	40		0.01	1	0.25	0.6	0.9	10	6	200		20		2	6	71
					50	45	80		0.1	1	0.5		1.2	50		166		0.1				
							90		1	1												
							100	600	10	1												
							100	400*	1	10												
BCY71A	TO-18	45	45		50	40	40		0.01	1	0.25	0.6	0.9	10	6	300		10		2	6	71
							80		0.1	1	0.5		1.2	50		15		1				
							90		1	1												
							100	600	10	1												
							100	400*	1	10											175	
BCY72	TO-18	25	25	5	50	20	40		1	1	0.25			10	6	200		10		6	6	71
					500	25	50		10	1	0.5		1.2	50					420		17	
BF153	TO-106	30	12	2	100	15	20		3	6	0.5			10	(CRE) 1.2	300		3		GT 40 dB Min		43
BF160	TO-106	30	12	2	500	15	20		3	10	0.5			10	1.7	400		10				43
BF167	TO-72(28)	40	30	4			27		4	10												45
BF173	TO-72(28)	40	25	4			38		7	10			0.9	7								47
BF194 (ST 194)	TO-92(71)	30	20	5			66	210	1	10		0.65	0.74	1								49
BF195 (ST 195)	TO-92(71)	30	20	5			35	125	1	10		0.65	0.74	1								49
BF196 (ST 196)	TO-92(71)	40	30	4			27		4	10			0.84	4								45
BF197 (ST 197)	TO-92(71)	40	25	4			38		7	10			0.9	7								47
BF198 (ST 198)	TO-92(71)	40	30	4			27		4	10			0.85	4								45
BF199 (ST 199)	TO-92(71)	40	25	4			38		7	10			0.925	7								47
BF233	TO-92(71)	30	20	5			35	120	1	10												49
BF257	TO-39	160	160	5	50	100	25		30	10	1			30	5.5	90		10			20	15

BF258	TO-39	250	250	5	50	100	25		30	10	1			30	5.5	90	10			20	15
BF259	TO-39	300	300	5	50	100	25		30	10	1			30	5.5	90	10			20	15
BF457 (NSD457)*	TO-202(35)	160	160	5	50	100	25		30	10	1			30							15
BF458 (NSD458)*	TO-202(35)	250	250	5	50	200	25		30	10	1			30							15
BF459 (NSD459)*	TO-202(35)	300	300	5	50	250	25		30	10	1			30							15
BFX13	TO-18	20	15	5	50	15	18		1	1	0.2		0.78	1	6	150	10		10	20	66
					500	20	50	250	10	0.35	0.25	0.7	0.9	10							
							10		100	2	1.5		1.5	100							
BFX29	TO-5	60	60		50	50	20		0.1	10	0.4		1.3	150	12	100	50	150		16	63
							40		1	10			0.9	30							
							50		10	10											
							50		50	10											
							100	400*	1	10											
							40		150	10											
BFX30	TO-5	65	65	5	50	50	40		1	0.4			0.9	30	12			290		15	63
					500	65	50	200	10	0.4			1.3	150							
							20		50	0.4											
							10		150	0.4											
BFX37	TO-18	60	60	6	20	50	70	300	0.01	5	0.25		0.9	10	6	40	0.5		3	21a	62
					I_{CES}		85		0.1	5	0.4		1	50					3	21b	
							100		1	5									3	21c	
							100		10	5											
BFX65	TO-18	45	45	6	10	40	100		0.1	5	0.25		0.9	10	6.5				3	4	62
					I_{CES}		100		1	5											
							100		10	5											
							120		1	5											
BFX84	TO-39	100	60	5	500	100	20		10	10	0.15		1.2	10	12	50	50	360		11	14
					50	80	30		150	10	0.35		1.3	150							
							20		500	10	1		1.5								
							15		1A	10	1.6		2	1A							
BFX85	TO-39	100	60	5	50	80	50		10	10	0.15		1.2	10	12	50	50	360		11	14
					500	100	70		150	10	0.35		1.3	150							
							30		500	10	1		1.5	500							
							15		1A	10	1.6		2	1A							
BFX86	TO-39	40	35	5	50	30	50		10	10	0.15		1.2	10	12	50	50	360		16	14
					500	40	70		150	10	0.35		1.3	150							
							30		500	10	1		1.5	500							
							15		1A	10	1.6		2	1A							
BFX87	TO-5	50	50	4	500	50	40		1	10	0.4		1.3	150	12	100	50	150		16	63
					50	40	40		10	10			0.9	30							
							40		150	10											
							25		500	10											

Test Conditions

1. I_C = 200μA, V_{CE} = 5.0V, R_S = 2.0 kΩ, f = 1.0 kHz, BW = 200 Hz
2. I_C = 200μA, V_{CE} = 5.0V, R_S = 2.0 kΩ, W.B.
3. I_C = 30μA, V_{CE} = 5.0V, R_S = 10 kΩ, f = 1.0 kHz, BW = 200 Hz
4. I_C = 20μA, V_{CE} = 5.0V, R_S = 10 kΩ, f = 1.0 kHz, BW = 150 Hz
5. I_C = 200μA, V_{CE} = 5.0V, R_G = 2.0 kΩ, f = 20 Hz to 15 kHz
6. I_C = 100μA, V_{CE} = 5.0V, R_S = 2.0 kΩ, f = 10 Hz to 10 kHz
7. I_C = 50μA, V_{CE} = 5.0V, R_S = 10 kΩ, BW = 10 Hz to 15 kHz
8. I_C = 50μA, V_{CE} = 5.0V, R_S = 10 kΩ, f = 1.0 kHz, BW = 200 Hz
9. I_C = 200μA, V_{CE} = 2.0V, R_S = 2.0 kΩ, f = 1.0 kHz, BW = 200 Hz
10. I_C = 10μA, V_{CE} = 5.0V, R_S = 10 kΩ, W.B.
11. I_C = 150 mA, V_{CE} = 10V, $I_{B1} = I_{B2}$ = 15 mA
12. I_C = 150 mA, $I_{B1} = I_{B2}$ = ±7.5 mA
13. I_C = 10 mA, I_{B1} = 3.0 mA, I_{B2} = 1.0 mA
14. I_C = 100 mA, I_{B1} = 40 mA, I_{B2} = 20 mA
15. V_{CC} = 10V, I_C = 100 mA $I_{B1} = I_{B2}$ = 10 mA
16. I_C = 150 mA, V_{CE} = 6.0V, $I_{B1} = I_{B2}$ = 15 mA
17. I_C = 10 mA, I_{B1} = 1.0 mA, I_{B2} = −1.0 mA
18. I_C = 300 mA, V_{CC} = 25V, $I_{B1} = I_{B2}$ = 30 mA
19. V_{CC} = 20V, I_C = 100 mA $I_{B1} = I_{B2}$ = 5.0 mA
20. I_C = 1.0 mA, V_{CE} = 5.0V, R_G = 2.0 kΩ, f = 1.0 kHz, BW = 200 Hz
21. I_C = 20μA, V_{CE} = 5.0V, R_S = 10 kΩ,
    a – f = 1.0 kHz, BW = 200 Hz
    b – f = 10 kHz, BW = 2.0 kHz
    c – BW = 15.7 kHz
22. I_C = 500 mA, V_{CC} = 25V, I_{B1} = 50 mA, I_{B2} = 25 mA

*Electrically but not identical to pro-electron type numbers.

Pro-Electron Series

Type No.	Case Style	V_{CBO} (V) Min	V_{CEO} (V) Min	V_{EBO} (V) Min	I_{CBO} (nA) Max	@ V_{CB} (V)	h_{FE} h_{fe} (1kHz)* Min	Max	@ I_C (mA)	V_{CE} (V)	$V_{CE(sat)}$ (V) Max	$V_{BE(sat)}$ $V_{BE(on)}$* (V) Min	Max	@ I_C (mA)	C_{ob} (pF) Max	f_T (MHz) Min	Max	@ I_C (mA)	t_{off} (ns) Max	NF (dB) Max	Test Condition	Process No.
BFX88	TO-5	40	40	4	50	30	40		1	10	0.4		1.3	150	12	100		50	150		16	63
							40		150	10			0.9	30								
							40		10	10												
							25		500	10												
BFY39	TO-18	45	25	5	50	30	35	400*	10	10	1		1	10	5	150		10				23
BFY39-1	TO-18	45	25	5	50	30	35	110	10	10	1		1	10	5	150		10				23
							120	*	1	5												
BFY39-2	TO-18	45	25	5	50	30	100	200	10	10	1		1	10	5	150		10				23
BFY39-3	TO-18	45	25	5	50	30	180	400	10	10	1		1	10	5	150		10				23
							120	*	1	5												
BFY50	TO-39	80	35	6	50	60	20		10	10	0.7		1.5	500	12	60		50	360		11	14
					500	80	30		150	10	0.1		1.2	10								
							20		500	10	0.2		1.3	150								
							15		1A	10	1		2	1A								
BFY51	TO-39	60	30	6	50	40	30		10	10	1		1.5	500	12	50		50	360		11	14
					500	60	40		150	10	0.15		1.2	10								
							25		500	10	0.35		1.3	150								
							15		1A	10	1.6		2	1A								
BFY52	TO-39	40	20	6	50	30	30		10	10	1		1.5	500	12	50		50	360		11	14
					500	40	60		150	10	0.15		1.2	10								
							30		500	10	0.35		1.3	150								
							15		1A	10	1.6		2	1A								
BFY56	TO-39	80	45	5	50	50	15		0.1	10	0.3		1.5	150	25	40		50	625		12	14
							20		500	10	2.3		1.2	100								
							30	150	150	1												
BFY72	TO-5	50	28	5	0.02	40	15		0.1	100	0.25		1.2	150	8	50		50	170		18	20
					I_{CES}		20		1	10	0.7		1.6	500								
							30		10	10												
							40	150	150	10												
							15		500	10												
BFY76	TO-18	45		6	20	30	80	550*	1	5		0.5	0.75	0.1	6	2.4		0.05		4	10	07
							30	200	0.01	5	0.35				6	2		0.5				
							80		0.5	5												
							140		1	5												
BSX21	TO-18	120	80	5	500	50	20		4	3			0.9	4		60		4				07
					0.04	120																
BSX45-6	TO-39	BV_{CES} 80	40	7	10	60	40	100	100	1	1			500	20	60		50	650		12	14
					I_{CES}								2	1000								
BSX45-10	TO-39	BV_{CES} 80	40	7	10	60	63	160	100	1	1			500	20	60		50	650		12	14
					I_{CES}								2	1A								
BSX45-16	TO-39	BV_{CES} 80	40	7	10	60	100	250	100	1	1			500	20	60		50	650		12	14
													2	1A								
BSX46-6	TO-39	BV_{CES} 100	60	7	10	60	40	100	100	1	1			500	25	60		50	650		12	14
													2	1A								
BSX46-10	TO-39	BV_{CES} 100	60	7	10	60	63	160	100	1	1			500	25	60		50	650		12	14
													2	1A								
BSX46-16	TO-39	BV_{CES} 100	60	7	10	60	100	250	100	1	1			500	25	60		50	650		12	14
													2	1A								

BSX48	TO-18	50	25	5	120	50	17		100	1	1.5		1.5	500		250	30	110		22	20
BSX88	TO-18	40	15	5	25	20	15 30	 120	0.5 10	1 1	0.4	0.72	0.8	10	6	300	10	75		13	21
BSY38	TO-18	20	12	5	100	20	30 15	60 45	10 100	0.35 1	0.25 0.6	0.7	0.85 1.5	10 100	5	200	10	45		14	21
BSY39	TO-18	20	12	5	100	20	40 20	120 70	10 100	0.35 1	0.25 0.6	0.7	0.85 1.5	10 100	5	200	10	45		14	21
BSY51	TO-5	60	25	5	100	30	40	120	150	10	1		1.3	150	9	130	50				20
BSY52	TO-5	60	25	5	100	30	100	300	150	10	1		1.3	150	9	130	50				20
BSY53	TO-5	75	30	7	10	60	20 35 40 20	 120 	0.1 10 150 500	10 10 10 10	0.6 2.0		1.3	150 500	9	150	50				20
BSY54	TO-5	75	30	7	10	60	35 75 100 40	 300 	0.1 10 150 500	10 10 10 10	0.6 2		1.3	150 500	9	150	50				20
BSY95A	TO-18	20	15	5	50	16	30 50	 200	1 10	0.35 0.35	0.35	0.67	0.87	10	6	200	10				21

Test Conditions

1. I_C = 200μA, V_{CE} = 5.0V, R_S = 2.0 kΩ, f = 1.0 kHz, BW = 200 Hz
2. I_C = 200μA, V_{CE} = 5.0V, R_S = 2.0 kΩ, W.B.
3. I_C = 30μA, V_{CE} = 5.0V, R_S = 10 kΩ, f = 1.0 kHz, BW = 200 Hz
4. I_C = 20μA, V_{CE} = 5.0V, R_S = 10 kΩ, f = 1.0 kHz, BW = 150 Hz
5. I_C = 200μA, V_{CE} = 5.0V, R_G = 2.0 kΩ, f = 20 Hz to 15 kHz
6. I_C = 100μA, V_{CE} = 5.0V, R_S = 2.0 kΩ, f = 10 Hz to 10 kHz
7. I_C = 50μA, V_{CE} = 5.0V, R_S = 10 kΩ, BW = 10 Hz to 15 kHz
8. I_C = 50μA, V_{CE} = 5.0V, R_S = 10 kΩ, f = 1.0 kHz, BW = 200 Hz
9. I_C = 200μA, V_{CE} = 2.0V, R_S = 2.0 kΩ, f = 1.0 kHz, BW = 200 Hz
10. I_C = 10μA, V_{CE} = 5.0V, R_S = 10 kΩ, W.B.
11. I_C = 150 mA, V_{CE} = 10V, $I_{B1} = I_{B2}$ = 15 mA
12. I_C = 150 mA, $I_{B1} = I_{B2}$ = ±7.5 mA
13. I_C = 10 mA, I_{B1} = 3.0 mA, I_{B2} = 1.0 mA
14. I_C = 100 mA, I_{B1} = 40 mA, I_{B2} = 20 mA
15. V_{CC} = 10V, I_C = 100 mA $I_{B1} = I_{B2}$ = 10 mA
16. I_C = 150 mA, V_{CE} = 6.0V, $I_{B1} = I_{B2}$ = 15 mA
17. I_C = 10 mA, I_{B1} = 1.0 mA, I_{B2} = −1.0 mA
18. I_C = 300 mA, V_{CC} = 25V, $I_{B1} = I_{B2}$ = 30 mA
19. V_{CC} = 20V, I_C = 100 mA $I_{B1} = I_{B2}$ = 5.0 mA
20. I_C = 1.0 mA, V_{CE} = 5.0V, R_G = 2.0 kΩ, f = 1.0 kHz, BW = 200 Hz
21. I_C = 20μA, V_{CE} = 5.0V, R_S = 10 kΩ,
    a – f = 1.0 kHz, BW = 200 Hz
    b – f = 10 kHz, BW = 2.0 kHz
    c – BW = 15.7 kHz
22. I_C = 500 mA, V_{CC} = 25V, I_{B1} = 50 mA, I_{B2} = 25 mA

*Electrically but not identical to pro-electron type numbers.

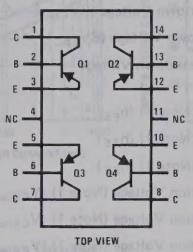
DH3467C Quad PNP Core Driver

DESCRIPTION

The DH3467C consists of four 2N3467 type PNP transistors mounted in a 14-pin molded dual-in-line package. The device is primarily intended for core memory application requiring operating currents in the ampere range, high stand-off voltage, and fast turn-on and turn-off times. Also available in ceramic dual-in-line package as DH3467CD.

CONNECTION DIAGRAM

Dual-In-Line Package
Order Number: DH3467CN or DH3467CD



TOP VIEW

TYPICAL CHARACTERISTICS

Turn-ON Time	20 ns
Turn-OFF Time	70 ns
Collector Current	1.0A
Collector-Base Breakdown Voltage	100V typ
Collector Saturation Voltage at I_C = 1.0A	0.6V
Collector Saturation Voltage at I_C = 0.5A	0.38V

SWITCHING TIME TEST CIRCUITS

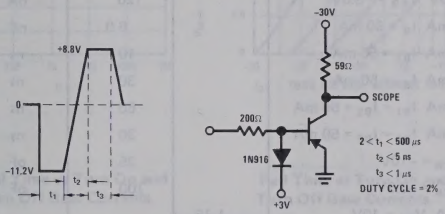


FIGURE 1. t_{on} Equivalent Test Circuit

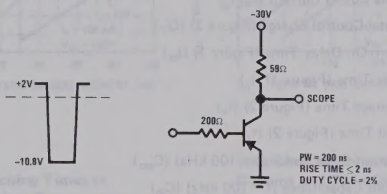
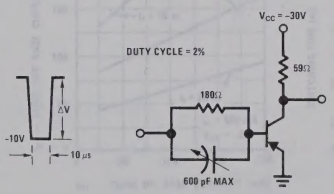


FIGURE 2. t_{off} Equivalent Test Circuit



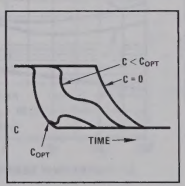


FIGURE 3. Q_T Test Circuit

ABSOLUTE MAXIMUM RATINGS

Collector to Base Voltage	40V
Collector to Emitter Voltage	40V
Collector to Emitter Voltage (Note)	40V
Emitter to Base Voltage	5V
Collector Current — Continuous	1.0A
Power Dissipation (T_A = 25°C) (each device)	0.85W
Power Dissipation (T_A = 25°C) (total package)	2.5W
Operating Junction Temperature	150°C Max
Operating Temperature Range	0°C to +85°C
Storage Temperature Range	−65°C to +150°C
Lead Temperature (Soldering, 10 sec.)	300°C

Note 1: Pulsed test, PW = 300µs, duty cycle = 1%

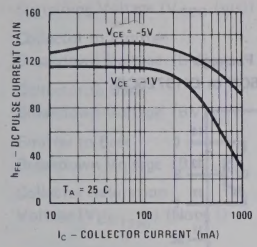
DH3467C

ELECTRICAL CHARACTERISTICS (T_A = 25°C, unless otherwise specified)

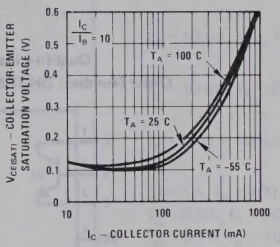
PARAMETER	CONDITIONS	LIMITS MIN	LIMITS MAX	UNITS
Collector to Base Breakdown Voltage (BV_{CBO})	I_C = 10 μA I_E = 0	-40		V
Emitter to Base Breakdown Voltage (BV_{EBO})	I_E = 10 μA I_C = 0	-5.0		V
Collector to Emitter Breakdown Voltage (Note 1) (BV_{CEO})	I_C = 10 mA I_B = 0	-40		V
DC Pulse Current Gain (Note 1) (h_{FE})	I_C = 150 mA V_{CE} = -1.0V	40		
DC Pulse Current Gain (Note 1) (h_{FE})	I_C = 500 mA V_{CE} = -1.0V	40	120	
DC Pulse Current Gain (Note 1) (h_{FE})	I_C = 1.0A V_{CE} = -5.0V	40		
Pulsed Collector Saturation Voltage (Note 1) ($V_{CE(sat)}$)	I_C = 150 mA I_B = 15 mA		-0.30	V
Pulsed Collector Saturation Voltage (Note 1) ($V_{CE(sat)}$)	I_C = 500 mA I_B = 50 mA		-0.50	V
Pulsed Collector Saturation Voltage (Note 1) ($V_{CE(sat)}$)	I_C = 1.0A I_B = 100 mA		-1.0	V
Pulsed Base Saturation Voltage (Note 1) ($V_{BE(sat)}$)	I_C = 150 mA I_B = 15 mA		-1.0	V
Pulsed Base Saturation Voltage (Note 1) ($V_{BE(sat)}$)	I_C = 500 mA I_B = 50 mA	-0.8	-1.2	V
Pulsed Base Saturation Voltage (Note 1) ($V_{BE(sat)}$)	I_C = 1.0A I_B = 100 mA		-1.6	V
Collector Cutoff Current (I_{CBO})	V_{CB} = -30V I_B = 0		100	nA
Collector Cutoff Current ($I_{CBO(100°C)}$)	V_{CB} = -30V I_B = 0		15	μA
Collector Cutoff Current (I_{CEX})	V_{CB} = -30V V_{EB} = -3.0V		100	nA
Base Cutoff Current (I_{BL})	V_{CB} = -30V V_{EB} = -3.0V		120	nA
Total Control Charge (Figure 3) (Q_T)	I_C = 500 mA I_B = 50 mA		6.0	nC
Turn On Delay Time (Figure 1) (t_d)	I_C = 500 mA I_{B1} = 50 mA		10	ns
Rise Time (Figure 1) (t_r)	I_C = 500 mA I_{B1} = 50 mA		30	ns
Storage Time (Figure 2) (t_s)	I_C = 500 mA I_{B1} = I_{B2} = 50 mA		60	ns
Fall Time (Figure 2) (t_f)	I_C = 500 mA I_{B1} = I_{B2} = 50 mA		30	ns
Output Capacitance (f = 100 kHz) (C_{ob})	I_E = 0 V_{CB} = -10V		25	pF
Input Capacitance (f = 100 kHz) (C_{ib})	I_C = 0 V_{CB} = -0.5V		100	pF
High Frequency Current Gain (f = 100 MHz) (h_{fe})	I_C = 50 mA V_{CE} = 10V	1.75		

Note 1: Pulsed test, PW = 300μs, duty cycle = 1%

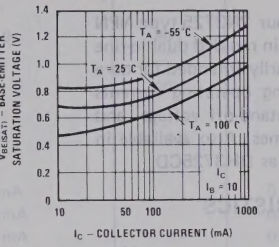
DC Pulse Current Gain vs Collector Current



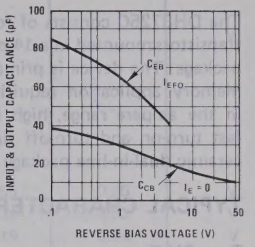
Collector-Emitter Saturation Voltage vs Collector Current



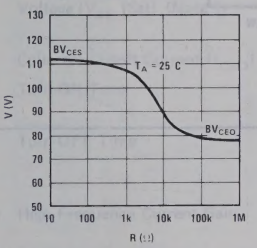
Base-Emitter Saturation Voltage vs Collector Current



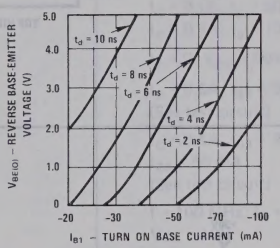
Input & Output Capacitance vs Reverse Bias Voltage



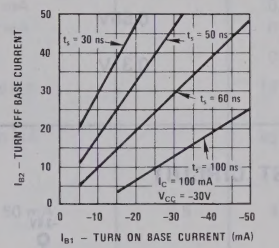
BV_{CER} vs R_{BE} I_C = 10 mA



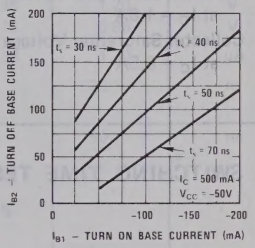
Delay Time vs Turn On Base Current and Reverse Base Emitter Voltage



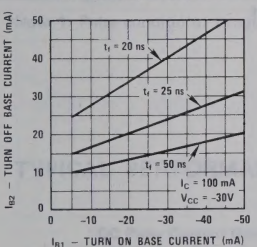
Storage Time vs Turn On and Turn Off Base Currents



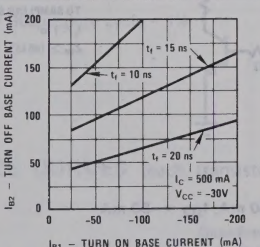
Storage Time vs Turn On and Turn Off Base Currents



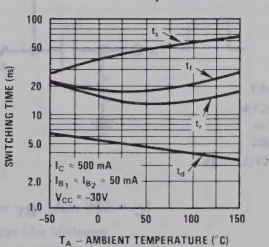
Fall Time vs Turn On and Turn Off Base Currents



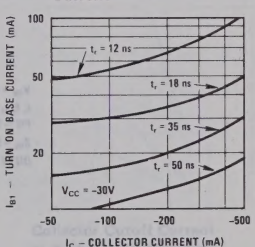
Fall Time vs Turn On and Turn Off Base Currents



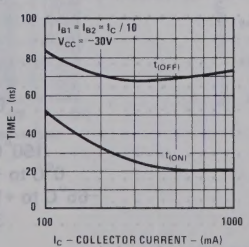
Switching Times vs Ambient Temperature



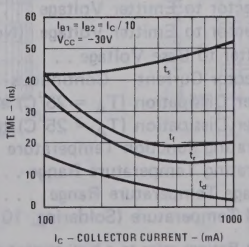
Rise Time vs Collector Current and Turn On Base Current



Turn On and Turn Off Times vs Collector Current



Switching Times vs Collector Current



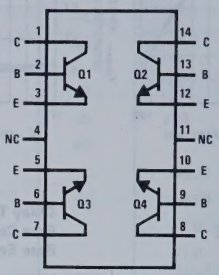
DH3725C Quad NPN Core Driver

DESCRIPTION

The DH3725C consists of four 2N3725 type NPN transistors mounted in a 14-pin molded dual-in-line package. The device is primarily intended for core memory application requiring operating currents in the ampere range, high stand-off voltage, and fast turn-on and turn-off times. Also available in ceramic dual-in-line package as DH3725CD.

CONNECTION DIAGRAM

Dual-In-Line Package
Order Number: DH3725CN or DH3725CD

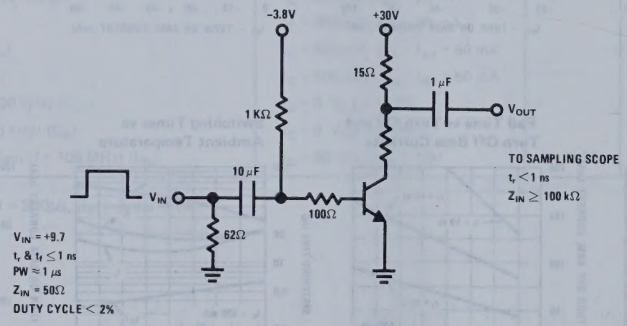


TOP VIEW

TYPICAL CHARACTERISTICS

Turn-ON Time	18 ns
Turn-OFF Time	55 ns
Collector Current	1.0A
Collector-Base Breakdown Voltage	120V typ
Collector Saturation Voltage at I_C = 1.0A	0.55V
Collector Saturation Voltage at I_C = 0.5A	0.31V

SWITCHING TIME TEST CIRCUIT



$I_C \approx 500$ mA, $I_{B1} \approx 50$ mA, $I_{B2} \approx -50$ mA

ABSOLUTE MAXIMUM RATINGS

Collector to Base Voltage	80V
Collector to Emitter Voltage	80V
Collector to Emitter Voltage (Note)	50V
Emitter to Base Voltage	6.0V
Collector Current — Continuous	1.0A
Power Dissipation (T_A = 25°C) each device	0.85W
Power Dissipation (T_A = 25°C) total package	2.5W
Operating Junction Temperature	150°C Max
Operating Temperature Range	0°C to +85°C
Storage Temperature Range	−65°C to +150°C
Lead Temperature (Soldering, 10 sec.)	300°C

Note: Ratings refer to a high-current point where collector-to-emitter voltage is lowest.

ELECTRICAL CHARACTERISTICS

Each transistor (T_A = 25°C, unless otherwise specified)

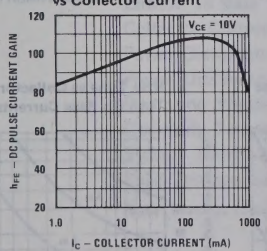
DH3725C

PARAMETER	CONDITIONS	LIMITS MIN	LIMITS TYP	LIMITS MAX	UNITS
Collector to Emitter Sustaining Voltage (V_{CEO} (sust))	I_C = 10 mA, I_B = 0	50			V
Collector to Emitter Breakdown Voltage (BV_{CES})	I_C = 10 μA, V_{BE} = 0	80			V
Collector to Base Breakdown Voltage (BV_{CBO})	I_C = 10 μA, I_E = 0	80			V
Emitter to Base Breakdown Voltage (BV_{EBO})	I_C = 0, I_E = 10 μA	6.0			V
Collector Saturation Voltage ($V_{CE\ (Sat)}$) (Note 1)	I_C = 1A, I_B = 100 mA		0.55	0.95	V
	I_C = 0.5A, I_B = 50 mA		0.31	0.52	V
	I_C = 0.1A, I_B = 10 mA		0.19	0.26	V
DC Pulse Current Gain (h_{FE}) (Note 1)	I_C = 1A, V_{CE} = 5V	25	65		
	I_C = 0.5A, V_{CE} = 1V	35	45		
	I_C = 0.1A, V_{CE} = 1V	60	90	150	
Base Saturation Voltage (V_{BE} (Sat) (Note 1)	I_C = 1A, I_B = 100 mA		1.10	1.70	V
	I_C = 0.5A, I_B = 50 mA		0.95	1.20	V
	I_C = 0.1A, I_B = 10 mA		0.75	0.86	V
Collector Cutoff Current (I_{CBO})	I_E = 0, V_{CB} = 60V		0.33	1.70	μA
Turn-ON Time	I_C = 0.5A, I_{B1} = 50 mA (See test circuit)		18	30	ns
Turn-OFF Time	I_C = 0.5A, I_{B1} = 50 mA I_{B2} = 50 mA (See test circuit)		45	60	ns
High Frequency Current Gain	f = 100 MHz, I_C = 50 mA, V_{CE} = 10V	2.5	4.5		
Common Base, Open Circuit, Output Capacitance	I_E = 0, V_{CB} = 10V		4.8	10	pF
Common Base, Open Circuit, Input Capacitance	I_C = 0, V_{BE} = 0.5V		40	55	pF

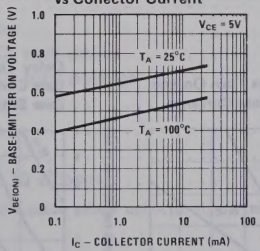
Note 1: Pulse conditions: Length = 300μs, duty cycle = 1%.

TYPICAL PERFORMANCE CURVES (each transistor)

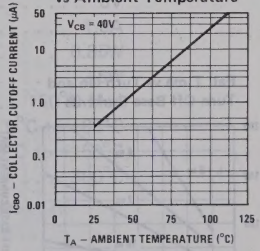
DC Pulse Current Gain vs Collector Current



Base-Emitter On Voltage vs Collector Current



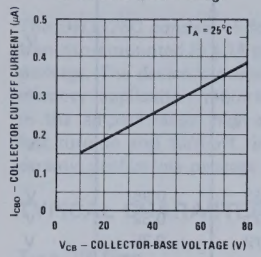
Collector Cutoff Current vs Ambient Temperature



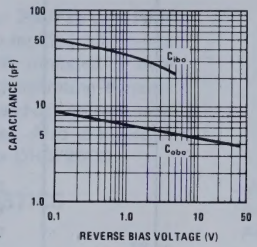
DH3725C

TYPICAL PERFORMANCE CURVES (each transistor)

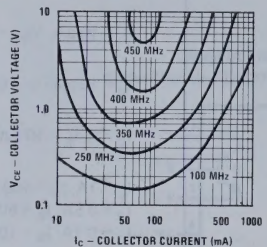
Collector Cutoff Current vs Reverse Bias Voltage



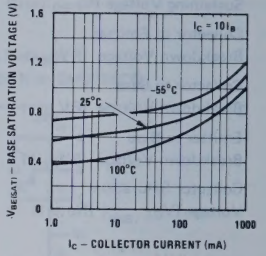
Input and Output Capacitance vs Reverse Bias



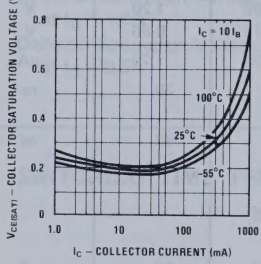
Contours of Constant Bandwidth Product (f_T)



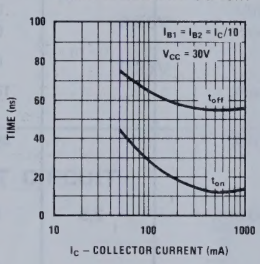
Base Saturation Voltage vs Collector Current



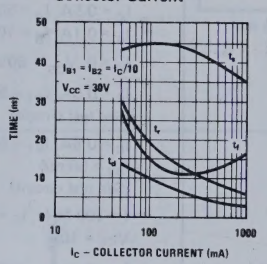
Collector Saturation Voltage vs Collector Current



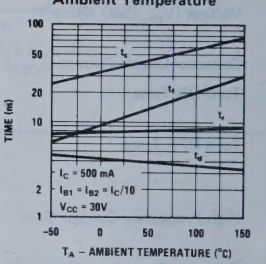
Turn On and Turn Off Times vs Collector Current



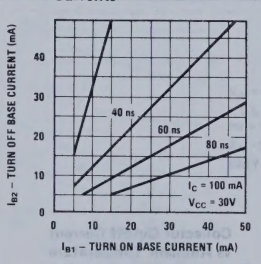
Switching Times vs Collector Current



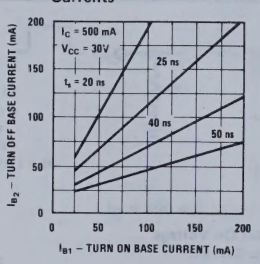
Switching Times vs Ambient Temperature



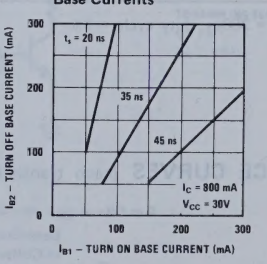
Storage Time vs Turn On and Turn Off Base Currents



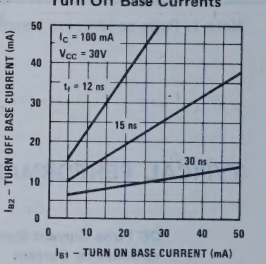
Storage Time vs Turn On and Turn Off Base Currents



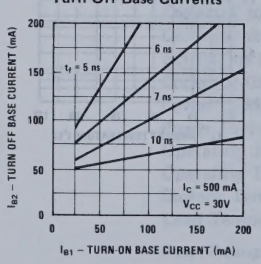
Storage Time vs Turn On and Turn Off Base Currents



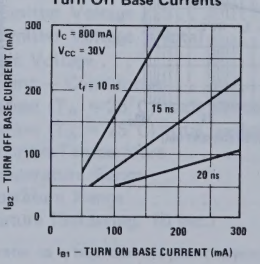
Fall Time vs Turn On and Turn Off Base Currents



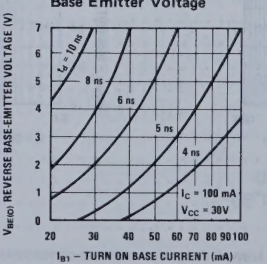
Fall Time vs Turn On and Turn Off Base Currents



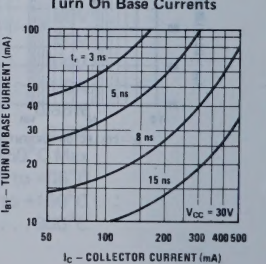
Fall Time vs Turn On and Turn Off Base Currents



Delay Time vs Turn On Base Current and Reverse Base Emitter Voltage



Rise Time vs Collector and Turn On Base Currents



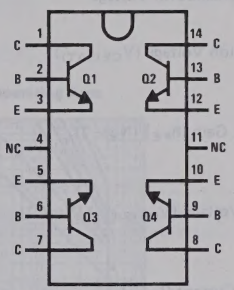
DH6376C Quad NPN Core Driver

DESCRIPTION

The DH6376C consists of four 2N6376 type NPN transistors mounted in a 14-pin molded dual-in-line package. The device is primarily intended for core memory application requiring operating currents in the ampere range, and fast turn-on and turn-off times. Also available in ceramic dual-in-line as DH6376CD.

CONNECTION DIAGRAM

Dual-In-Line Package
Order Number: DH6376CN or DH6376CD



TOP VIEW

TYPICAL CHARACTERISTICS

Turn-On Time	12 ns
Turn-Off Time	28 ns
Collector Current	1A
Collector-Base Breakdown Voltage	110V typ.
Collector Saturation Voltage at I_C = 1A	0.48V
Collector Saturation Voltage at I_C = 0.5A	0.31V

ABSOLUTE MAXIMUM RATINGS

Collector to Base Voltage	75V
Collector to Emitter Voltage (Note)	40V
Emitter to Base Voltage	6V
Collector Current — Continuous	1.0A
Power Dissipation (T_A = 25°C) each device	0.85W
Power Dissipation (T_A = 25°C) total package	2.5W
Operating Junction Temperature	150°C Max
Operating Temperature Range	0°C to +85°C
Storage Temperature Range	−65°C to +150°C
Lead Temperature (Soldering, 10 seconds)	300°C

Note: Ratings refer to a high-current point where collector-to-emitter voltage is lowest.

DH6376C

ELECTRICAL CHARACTERISTICS

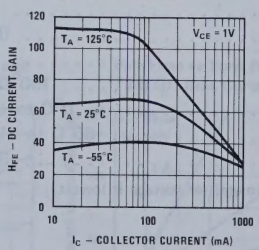
Each transistor (T_A = 25°C, unless otherwise specified)

PARAMETER	CONDITIONS	LIMITS			UNITS
		MIN	TYP	MAX	
Collector to Emitter Sustaining Voltage (V_{CEO} (sust))	I_C = 10 mA, I_B = 0	40			V
Collector to Base Breakdown Voltage (BV_{CBO})	I_C = 10 μA, I_E = 0	75			V
Emitter to Base Breakdown Voltage (BV_{EBO})	I_C = 0, I_E = 10 μA	6.0			V
Collector Saturation Voltage ($V_{CE(SAT)}$) (Note 1)	I_C = 1A, I_B = 100 mA		0.48	0.55	V
	I_C = 0.5A, I_B = 50 mA		0.31	0.4	V
	I_C = 0.1A, I_B = 10 mA		0.19	0.25	V
DC Pulse Current Gain (h_{FE}) (Note 1)	I_C = 1A, V_{CE} = 1V	20			
	I_C = 0.5A, V_{CE} = 1V	30		90	
	I_C = 0.1A, V_{CE} = 1V	60			
Base Saturation Voltage ($V_{BE(SAT)}$) (Note 1)	I_C = 1A, I_B = 100 mA		1.05	1.20	V
	I_C = 0.5A, I_B = 50 mA		0.93	1.00	V
	I_C = 0.1A, I_B = 10 mA		0.75	0.80	V
Collector Cutoff Current (I_{CBO})	I_E = 0, V_{CB} = 60V			0.5	μA
Turn-ON Time	I_C = 0.5A, I_{B1} = 50 mA (See test circuit)	10	12	20	ns
Turn-OFF Time	I_C = 0.5A, I_{B1} = 50 mA, I_{B2} = 50 mA (See test circuit)	20	28	35	ns
High Frequency Current Gain	f = 100 MHz, I_C = 50 mA, V_{CE} = 10 V	3.0			
Common Base, Open Circuit, Output Capacitance	I_E = 0, V_{CB} = 10V			9	pF
Common Base, Open Circuit, Input Capacitance	I_C = 0, V_{BE} = 0.5V			60	pF

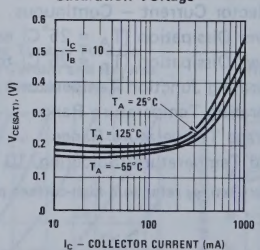
Note 1: Pulse conditions: Length = 300μs, duty cycle = 1%.

TYPICAL PERFORMANCE CURVES (each transistor)

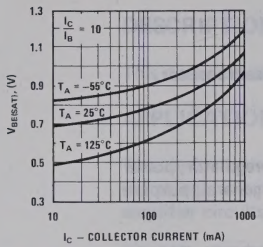
DC Current Gain vs Collector Current



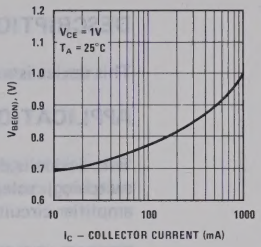
$V_{CE(SAT)}$, Collector Saturation Voltage



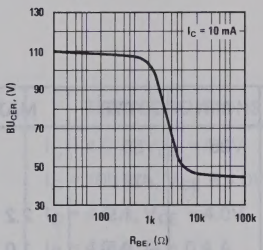
$V_{BE(SAT)}$, Base Saturation Voltage



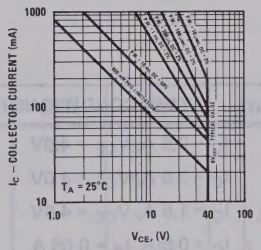
$V_{BE(ON)}$, Base Emitter On Voltage



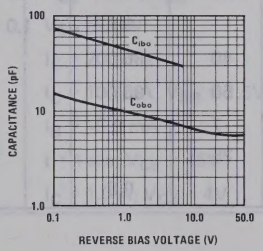
BV_{CER} vs R_{BE}



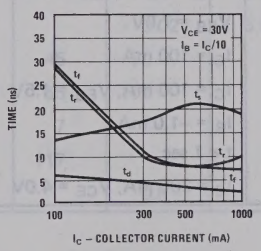
Safe Operating Area



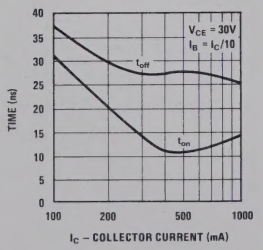
Capacitance vs Reverse Bias Voltage



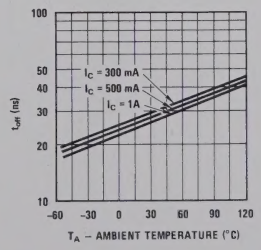
Switching Times vs Collector Current



Turn On and Turn Off Times vs Collector Current



t_{off} vs Ambient Temperature



Process 1A NPN Power

DESCRIPTION

This device is a single diffused, mesa transistor.

APPLICATION

This device is designed for use in regulator, power switching, solenoid driver, and general purpose amplifier circuits.

PRIME JEDEC TYPES:

2N3054

PARAMETER	TEST CONDITIONS (T_C = 25°C)	MIN	TYP	MAX	UNITS
h_{FE}	I_C = 0.5 A, V_{CE} = 4.0V	25	50		
h_{FE}	I_C = 3.0 A, V_{CE} = 4.0V	5	12		
$V_{BE(ON)}$	I_C = 1.5 A, V_{CE} = 4.0V		1.5	2.2	V
$V_{CE(SAT)}$	I_C = 0.5 A, I_B = 0.05 A		0.5	1.0	V
$V_{CE(SAT)}$	I_C = 1.5 A, I_B = 0.15 A		1.0	1.5	V
I_{CEO}	V_{CE} = 30V		0.1	1.0	mA
I_{CEX}	V_{CE} = 90V, V_{EB} = 1.5V		0.1	1.0	mA
I_{EBO}	V_{EB} = 7.0V		0.02	1.0	mA
$V_{CEO(SUS)}$	I_C = 100 mA	40	60		V
$V_{CEX(SUS)}$	I_C = 100 mA, V_{EB} = 1.5V	50	95		V
V_{EBO}	I_B = −1.0 mA	7			V
POWER TEST	t = 1 sec	25			W
f_T	I_C = 200 mA, V_{CE} = 4.0V		0.8		MHz

Process 1B NPN Power

DESCRIPTION

This device is a single diffused, mesa transistor.

APPLICATION

This device is designed for use in regulator, power switching, solenoid driver, and general purpose amplifier circuits.

PRIME JEDEC TYPES:

2N3055, 2N6253

PARAMETER	TEST CONDITIONS ($T_C = 25°C$)	MIN	TYP	MAX	UNIT
h_{FE}	$I_C = 4.0$ A, $V_{CE} = 4.0$V	15	33		
h_{FE}	$I_C = 100$ mA, $V_{CE} = 4.0$V		56		
$V_{BE(ON)}$	$I_C = 4.0$ A, $V_{CE} = 4.0$V			1.8	V
$V_{CE(SAT)}$	$I_C = 4.0$ A, $I_B = 0.4$ A		0.5	1.1	V
$V_{CE(SAT)}$	$I_C = 15.0$ A, $I_B = 5.0$ A			4	V
I_{CEO}	$V_{CE} = 30$V			1.8	mA
I_{CEX}	$V_{CE} = 55$V, $V_{EB} = 1.5$V		0.1	2.0	mA
I_{EBO}	$V_{EB} = 7.0$V		0.02	5.0	mA
$V_{CEO(SUS)}$	$I_C = 200$ mA	45	80		V
$V_{CEX(SUS)}$	$I_C = 100$ mA, $V_{EB} = 1.5$V	55	100		V
V_{EBO}	$I_B = -5.0$ mA	7			V
POWER TEST	t = 1 sec, $V_{CE} = 45$V	117			W
f_T	$I_C = 1.0$ A, $V_{CE} = 4$V		0.8		MHz

Process 1C NPN Power

DESCRIPTION

This device is a single diffused, mesa transistor.

APPLICATION

This device is designed for use in regulator, power switching, solenoid driver, and general purpose amplifier circuits.

PRIME JEDEC TYPES:

2N3442, 2N4347

PARAMETER	TEST CONDITIONS (T_C = 25°C)	MIN	TYP	MAX	UNIT
h_{FE}	I_C = 3 A, V_{CE} = 4.0V	13	25		
h_{FE}	I_C = 100 mA, V_{CE} = 4.0V		70		
$V_{BE(ON)}$	I_C = 3.0 A, V_{CE} = 4.0V		1	2	V
$V_{CE(SAT)}$	I_C = 3.0 A, I_B = 0.3 A		0.6	1	V
$V_{CE(SAT)}$					
I_{CEO}	V_{CE} = 100V			200	mA
I_{CEX}	V_{CE} = 125V, V_{EB} = 1.5V		0.1	2.0	mA
I_{EBO}	V_{EB} = 7.0V		0.02	5.0	mA
$V_{CEO(SUS)}$	I_C = 200 mA	120	150		V
$V_{CEX(SUS)}$	I_C = 100 mA, V_{EB} = 1.5V	140	165		V
V_{EBO}	I_B = –5.0 mA	7			V
POWER TEST	t = 1 sec., I_C = 1.5A	100	117		W

Process 1D NPN Power

DESCRIPTION

This device is a single diffused, mesa transistor.

APPLICATION

This device is designed for use in regulator, power switching, solenoid driver, and general purpose amplifier circuits.

PRIME JEDEC TYPES:

2N3771, 2N3772

PARAMETER	TEST CONDITIONS (T_C = 25°C)	MIN	TYP	MAX	UNIT
h_{FE}	I_C = 20 A, V_{CE} = 4V	5	10		
h_{FE}	I_C = 10 A, V_{CE} = 4V	15	25		
$V_{BE(ON)}$	I_C = 10 A, V_{CE} = 4V		1.5	2.2	V
$V_{CE(SAT)}$	I_C = 10 A, I_B = 1.0 A		0.7	1.4	V
$V_{CE(SAT)}$	I_C = 20 A, I_B = 4.0 A		1.5	4.0	V
I_{CEO}	V_{CE} = 30V			10	mA
I_{CEX}	V_{CE} = 50V, V_{EB} = 1.5V		0.1	2.0	mA
I_{EBO}	V_{EB} = 7V		0.02	5.0	mA
$V_{CEO(SUS)}$	I_C = 200 mA	40	70		V
$V_{CEX(SUS)}$	I_C = 200 mA, V_{EB} = 1.5V	50	90		V
V_{EBO}	I_B = –5.0 mA	7.0			V
POWER TEST	t = 1 sec., V_{CE} = 40V	150			W
f_T	I_C = 1.0 A, V_{CE} = 4.0V		0.8		MHz

Process 1E NPN Power

DESCRIPTION

This device is a single diffused, mesa transistor.

APPLICATION

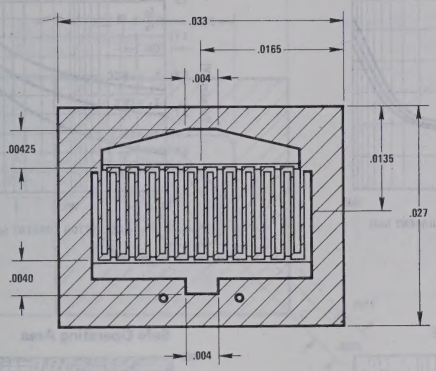
This device is designed for use in regulator, power switching, solenoid driver, and general purpose amplifier circuits.

PRIME JEDEC TYPES:

2N3773, 2N4348

PARAMETER	TEST CONDITIONS (T_C = 25°C)	MIN	TYP	MAX	UNIT
h_{FE}	I_C = 10 A, V_{CE} = 4.0V	10	15		
h_{FE}	I_C = 5 A, V_{CE} = 4.0V	15	30		
$V_{BE(ON)}$	I_C = 5 A, V_{CE} = 4.0V		1.0	2.0	V
$V_{CE(SAT)}$	I_C = 10 A, I_B = 1.25 A		0.7	2.0	V
$V_{CE(SAT)}$	I_C = 5 A, I_B = 0.5 A		0.35	1.0	V
I_{CEO}	V_{CE} = 100V			200	mA
I_{CEX}	V_{CE} = 120V, V_{EB} = 1.5V		0.2	2.0	mA
I_{EBO}	V_{EB} = 7V		0.1	5.0	mA
$V_{CEO(SUS)}$	I_C = 200 mA	120	150		V
$V_{CEX(SUS)}$	I_C = 100 mA, V_{EB} = 1.5V	140	165		V
V_{EBO}	I_B = 5.0 mA	7			V
POWER TEST	t = 1 sec., I = 1.5 A	120	150		W

Process 01 NPN High Speed Memory Driver



DESCRIPTION

Process 01 is an overlay double diffused, gold doped epitaxial device.

APPLICATION

This device was designed for ultra high speed core driver applications where predictable switching speed is a prime consideration.

PRINCIPAL DEVICE TYPES

TO-18 2N6375
TO-39 (PKG 17) 2N6376

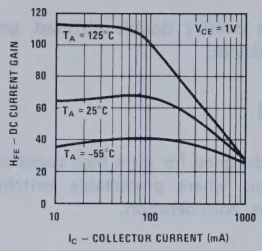
OTHER DEVICE TYPES

See pages 3 and 4.

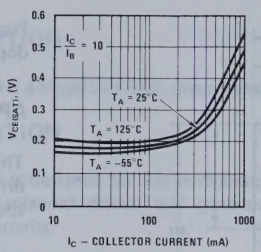
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
t_{on}	V_{CE} = 30V, I_C = 300 mA, I_{B_1} = 30 mA	10	14	20	ns	
t_{off}	V_{CE} = 30V, I_C = 300 mA, I_{B_1} = $-I_{B_2}$ = 30 mA	20	27	40	ns	
t_{on}	V_{CE} = 30V, I_C = 500 mA, I_{B_1} = 50 mA	8	10	16	ns	
t_{off}	V_{CE} = 30V, I_C = 500 mA, I_{B_1} = $-I_{B_2}$ = 50 mA	20	28	40	ns	
t_{on}	V_{CE} = 30V, I_C = 1 Amp, I_{B_1} = 100 mA	10	14	25	ns	
t_{off}	V_{CE} = 30V, I_C = 1 Amp, I_{B_1} = $-I_{B_2}$ = 100 mA	15	25	35	ns	
h_{FE}	V_{CE} = 10V, I_C = 50 mA, f = 100 MHz	3.0	4.2			
C_{CB}	V_{CB} = 10V		6.5	10	pF	
C_{EB}	V_{EB} = 0.5V		55	65	pF	
H_{FE}	V_{CE} = 1V, I_C = 10 mA	60				
H_{FE}	V_{CE} = 1V, I_C = 100 mA	60				
H_{FE}	V_{CE} = 1V, I_C = 300 mA	50				
H_{FE}	V_{CE} = 1V, I_C = 500 mA	30		90		
H_{FE}	V_{CE} = 1V, I_C = 1 Amp	20				
$V_{CE(SAT)}$	I_C = 100 mA, I_B = 10 mA		0.17	0.25	V	
$V_{CE(SAT)}$	I_C = 300 mA, I_B = 30 mA		0.22	0.35	V	
$V_{CE(SAT)}$	I_C = 500 mA, I_B = 50 mA		0.30	0.40	V	
$V_{CE(SAT)}$	I_C = 1 Amp, I_B = 100 mA		0.49	0.55	V	
$V_{BE(SAT)}$	I_C = 100 mA, I_B = 10 mA		0.77	0.8	V	
$V_{BE(SAT)}$	I_C = 300 mA, I_B = 30 mA	0.8	0.86	0.9	V	
$V_{BE(SAT)}$	I_C = 500 mA, I_B = 50 mA	0.85	0.94	1.0	V	
$V_{BE(SAT)}$	I_C = 1 Amp, I_B = 100 mA	0.95	1.08	1.2	V	
I_{CBO}	V_{CB} = 40V			0.2	μA	
I_{EBO}	V_{EB} = 4V			0.2	μA	
BV_{CBO}	I_C = 10 μA	75	116		V	
BV_{EBO}	I_E = 10 μA	6.0	7.6		V	
BV_{CEO}	I_C = 10 mA	30	40		V	

Process 01

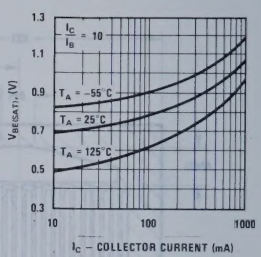
DC Current Gain vs Collector Current



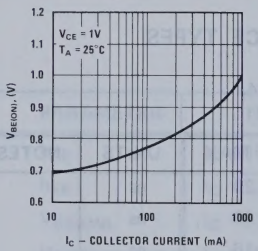
$V_{CE(SAT)}$, Collector Saturation Voltage



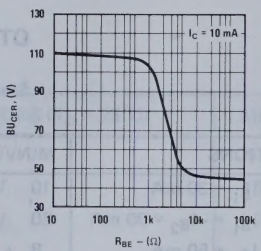
$V_{BE(SAT)}$, Base Saturation Voltage



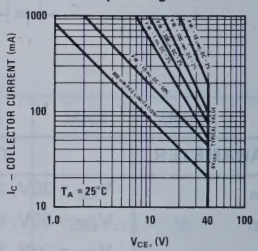
$V_{BE(ON)}$, Base Emitter On Voltage



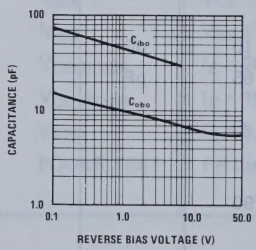
BV_{CER} vs R_{BE}



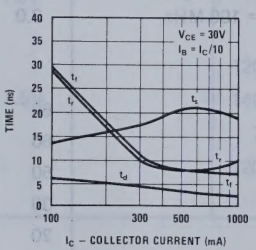
Safe Operating Area



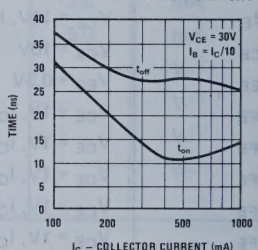
Capacitance vs Reverse Bias Voltage



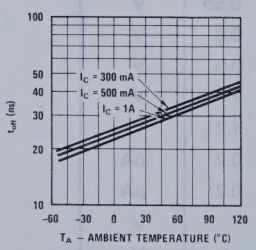
Switching Times vs Collector Current



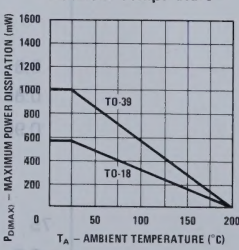
Turn On and Turn Off Times vs Collector Current



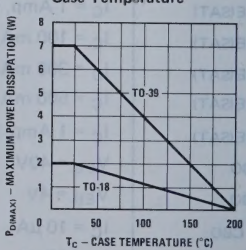
t_{off} vs Ambient Temperature



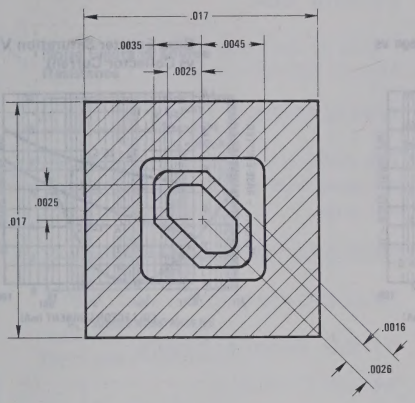
Maximum Power Dissipation vs Ambient Temperature



Maximum Power Dissipation vs Case Temperature



Process 04 NPN Small Signal



DESCRIPTION

Process 04 is a non-overlay double diffused silicon epitaxial device. Complement to Process 71.

APPLICATION

This device was designed for low noise, high gain, general purpose amplifier application. From 1 μA to 100 mA collector current.

PRINCIPAL DEVICE TYPES:

TO-18	BC107 Series
TO-92 (ECB)	2N2925

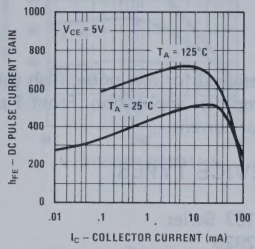
OTHER DEVICE TYPES

See pages 14, 15 and 18.

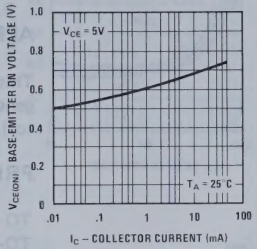
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
NF (spot)	I_C = 200 μA, V_{CE} = 5V f = 1 kHz, R_S = 2k		1.0	3.0	dB	TO-18
C_{ob}	V_{CB} = 10V, f = 1 MHz		2.5	3.0	pF	TO-18
C_{ib}	V_{EB} = 0.5V, f = 1 MHz		7.0	8.0	pF	TO-18
f_t	V_{CE} = 5V, I_C = 10 mA	150	350		MHz	
h_{FE}	V_{CE} = 5V, I_C = 100 μA	50	250	500		
h_{FE}	V_{CE} = 5V, I_C = 2 mA	100	400	750		
h_{FE}	V_{CE} = 5V, I_C = 100 mA	75	250	300		
h_{FE}	V_{CE} = 1V, I_C = 100 mA	30	100	150		
$V_{CE(sat)}$	I_C = 10 mA, I_B = 1 mA		0.040	0.080	V	
$V_{CE(sat)}$	I_C = 100 mA, I_B = 5 mA		0.150	0.200	V	
$V_{BE(sat)}$	I_C = 10 mA, I_B = 1 mA		0.75	0.85	V	
BV_{CBO}	I_C = 10 μA	115	125		V	
BV_{CEO}	I_C = 10 mA	45	50		V	
BV_{EBO}	I_E = 10 μA	8.0	9.0		V	
I_{CBO}	V_{CB} = 40V			10	NA	
I_{EBO}	V_{EB} = 4V			10	NA	

Process 04

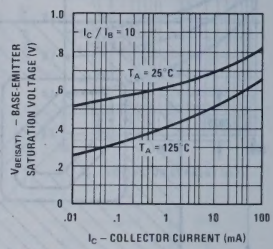
Pulsed DC Current Gain vs Collector Current



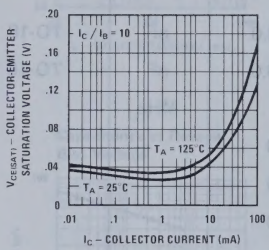
Base-Emitter On Voltage vs Collector Current



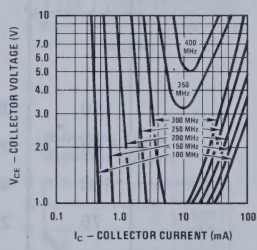
Base-Emitter Saturation Voltage vs Collector Current



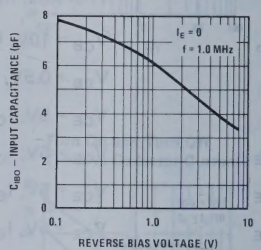
Collector-Emitter Saturation Voltage vs Collector Current



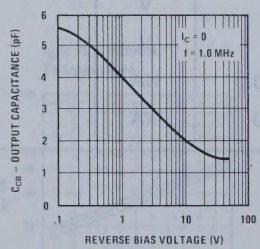
Contours of Constant Gain Bandwidth Product (F_T)



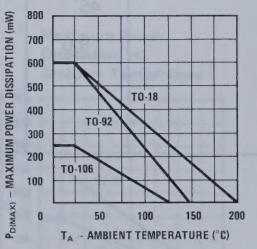
Input Capacitance vs Reverse Bias Voltage



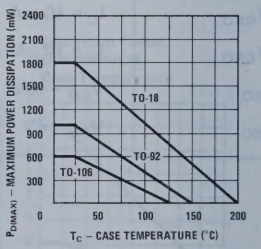
Output Capacitance vs Reverse Bias Voltage



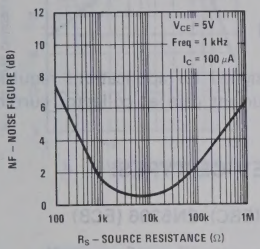
Maximum Power Dissipation vs Ambient Temperature



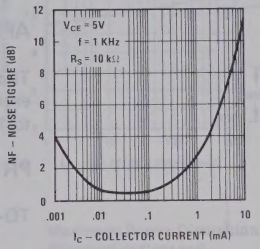
Maximum Power Dissipation vs Case Temperature



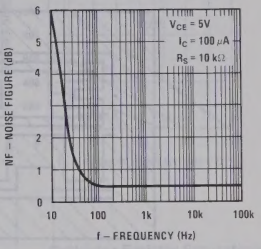
Noise Figure vs Source Resistance



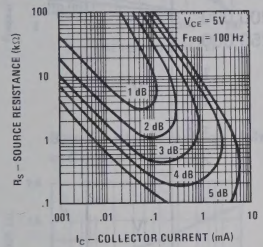
Noise Figure vs Collector Current



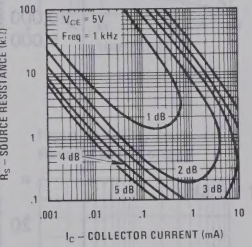
Noise Figure vs Frequency



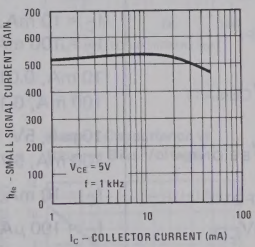
Contours of Constant Narrow Band Noise Figure



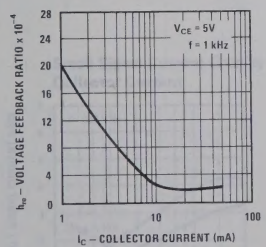
Contours of Constant Narrow Band Noise Figure



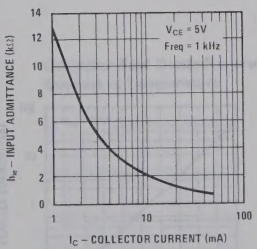
Small Signal Current Gain



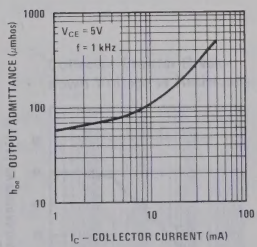
Voltage Feedback Ratio



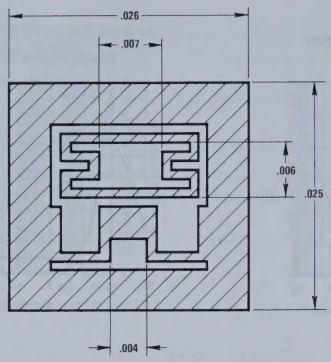
Input Admittance



Output Admittance



Process 05 NPN Darlington



DESCRIPTION

Process 05 is a monolithic double diffused, silicon epitaxial Darlington.

APPLICATION

This device is designed for applications requiring extremely high current gain at collector currents to 1 Amp.

PRINCIPAL DEVICE TYPES:

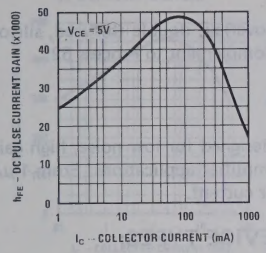
TO-92, MPS-A12 (EBC), 2N5306 (ECB)

OTHER DEVICE TYPES

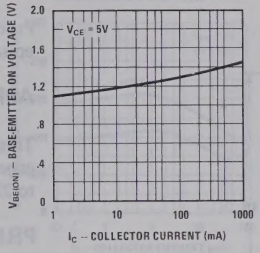
See pages 23 and 28.

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
NF	I_C = 1 mA, V_{CE} = 5V, R_S = 100 k, f = 1 kHz		2		dB	
C_{cb}	V_{CB} = 10V, I_E = 0, f = 1 MHz		4	8	pF	
h_{FE}	I_C = 10 mA, V_{CE} = 5V	20,000	80,000	200,000		
	I_C = 100 mA, V_{CE} = 5V	5,000	100,000	250,000		
$V_{CE(SAT)}$	10 mA, 0.01 mA			1.0	V	
	100 mA, 0.1 mA			1.5		
$V_{BE(ON)}$	10 mA, 5V		1.2	1.4	V	
	100 mA, 5V		1.25	2.0		
h_{FE}	I_C = 10 mA, V_{CE} = 5.0V, f = 1 kHz		80,000			
BV_{CES}	I_C = 100 μA	20	45		V	
I_{CES}	V_{CE} = 15V, V_{BE} = 0			100	nA	
I_{CBO}	V_{CB} = 15V, I_E = 0			100	nA	
I_{EBO}	V_{EB} = 10V, I_C = 0			100	nA	

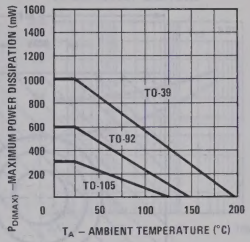
DC Pulse Current Gain vs Collector Current



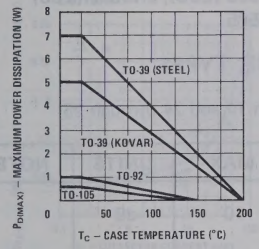
Base-Emitter On Voltage vs Collector Current



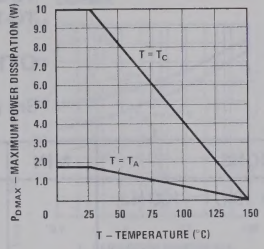
Maximum Power Dissipation vs Ambient Temperature



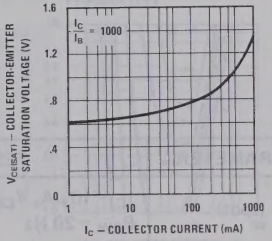
Maximum Power Dissipation vs Case Temperature



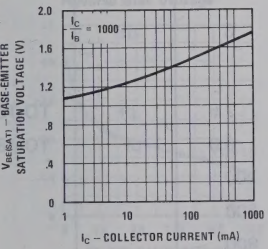
Maximum Power Dissipation Durawatt vs Case and Ambient Temperature



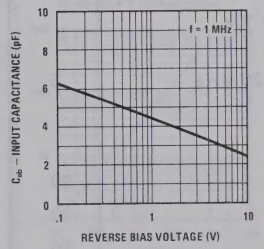
Collector-Emitter Saturation Voltage vs Collector Current



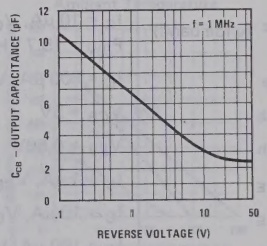
Base-Emitter Saturation Voltage vs Collector Current



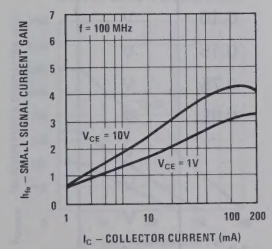
Input Capacitance vs Reverse Bias Voltage



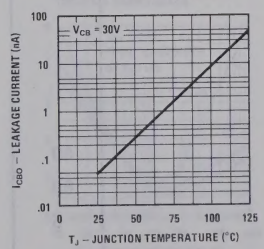
Output Capacitance vs Reverse Bias Voltage



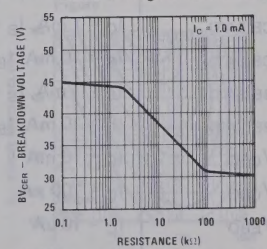
Small Signal Current Gain vs Collector Current



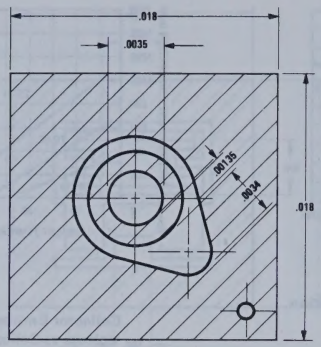
Collector-Base Diode Reverse Current vs Temperature



Collector-Emitter Breakdown Voltage vs Resistance



Process 07 NPN Small Signal



DESCRIPTION

Process 07 a nonoverlay, double diffused, silicon epitaxial device. Complement to Process 62.

APPLICATION

This device was designed for low noise, high gain general purpose amplifier applications. From 1 μA to 25 mA collector current.

PRINCIPAL DEVICE TYPES:

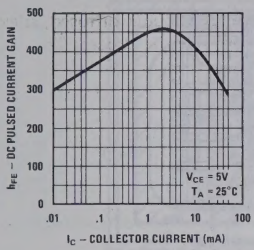
TO-18	2N930
TO-71	2N2979
TO-78	2N2920
TO-92	2N5088 (EBC), 2N3392 (ECB)
TO-106	2N3565

OTHER DEVICE TYPES

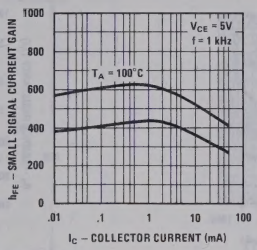
See pages 8 through 11 and 24 through 26.

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
NF (spot)	I_C = 10 μA, V_{CE} = 5V, R_S = 10k, f = 100 Hz, P_{BW} = 20 Hz		3	10	dB	
NF (spot)	I_C = 10 μA, V_{CE} = 5V, R_S = 10k, f = 1 kHz P_{BW} = 200 Hz		1	3	dB	
NF (spot)	I_C = 10 μA, V_{CE} = 5V, R_S = 10k, f = 10 kHz, P_{BW} = 2 kHz		1	3	dB	
NF (wide band)	I_C = 10 μA, V_{CE} = 5V, R_S = 10k, P_{BW} = 15.7 kHz		1	3	dB	
h_{fe}	I_C = 500 μA, V_{CE} = 5V, f = 20 MHz	5	7			
C_{cb}	V_{CB} = 5V		1.7	2.5	pF	TO-18
C_{eb}	V_{EB} = 0.50V		4.5	6.0	pF	TO-18
h_{FE}	I_C = 1 μA, V_{CE} = 5V	20	200	200		
h_{FE}	I_C = 10 μA, V_{CE} = 5V	20	300	600		
h_{FE}	I_C = 100 μA, V_{CE} = 5V	20	350	800		
h_{FE}	I_C = 500 μA, V_{CE} = 5V	20	425	1000		
h_{FE}	I_C = 1 mA, V_{CE} = 5V	20	450	1000		
h_{FE}	I_C = 10 mA, V_{CE} = 5V	20	425	1000		
$V_{CE(SAT)}$	I_C = 1 mA, I_B = 0.10 mA		0.06	0.10	V	
$V_{CE(SAT)}$	I_C = 10 mA, I_B = 1 mA		0.08	0.15	V	
$V_{BE(SAT)}$	I_C = 1 mA, I_B = 0.1 mA		0.65	0.75	V	
$V_{BE(SAT)}$	I_C = 10 mA, I_B = 1 mA		0.70	0.85	V	
BV_{CEO}	I_C = 10 mA	60			V	
BV_{CBO}	I_C = 100 μA	60			V	
BV_{EBO}	I_C = 10 μA	6			V	
I_{CBO}	V_{CB} = 45V			10	nA	
I_{EBO}	V_{EB} = 4V			10	nA	

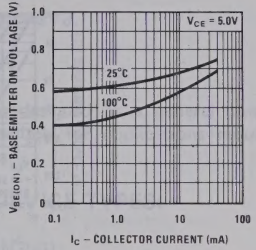
Pulsed DC Current Gain vs Collector Current



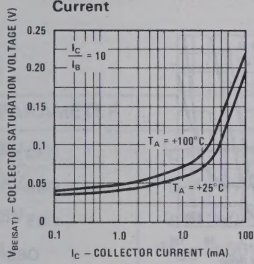
Small Signal Current Gain vs Collector Current



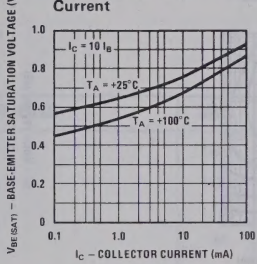
Base-Emitter On Voltage vs Collector Current



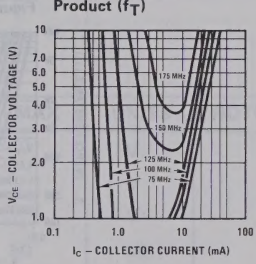
Collector Saturation Voltage vs Collector Current



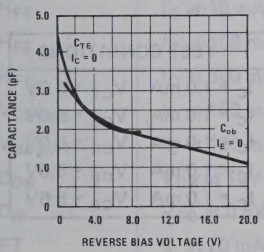
Base-Emitter Saturation Voltage vs Collector Current



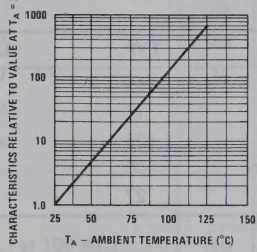
Contours of Constant Gain Bandwidth Product (f_T)



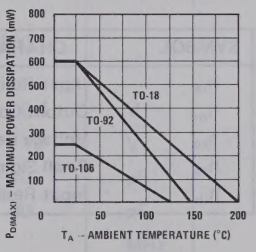
Input and Output Capacitance vs Reverse Bias Voltage



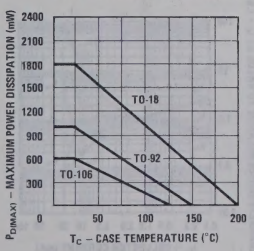
Normalized Collector Cutoff Current vs Ambient Temperature



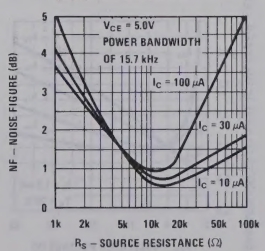
Maximum Power Dissipation vs Ambient Temperature



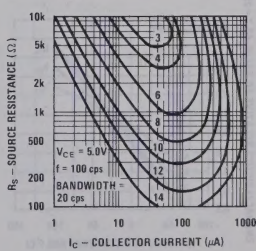
Maximum Power Dissipation vs Case Temperature



Wide Band Noise Figure vs Source Resistance

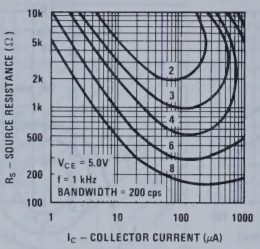


Contours of Constant Narrow Band Noise Figure

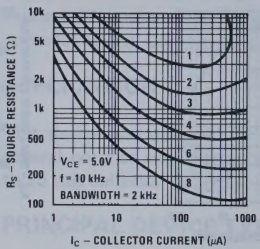


Process 07

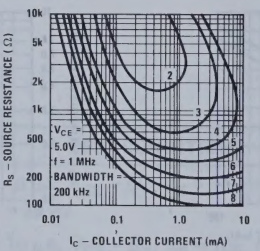
Contours of Constant Narrow Band Noise Figure



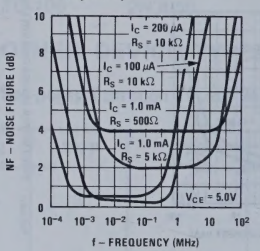
Contours of Constant Narrow Band Noise Figure



Contours of Constant Narrow Band Noise Figure



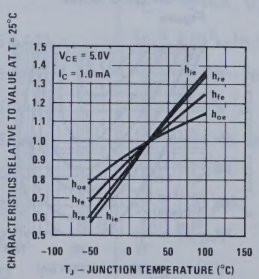
Noise Figure vs Frequency

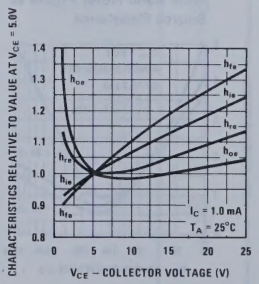


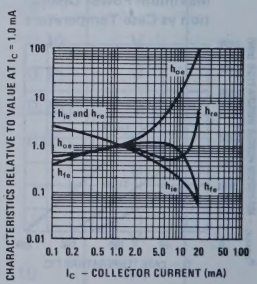
SMALL SIGNAL CHARACTERISTICS (f = 1.0 kHz)

SYMBOL	CHARACTERISTIC	TYP.	UNITS	TEST CONDITIONS
h_{ie}	Input Resistance	15	kΩ	I_C = 1.0 mA V_{CE} = 5.0V
h_{oe}	Output Conductance	15	μmho	I_C = 1.0 mA V_{CE} = 5.0V
h_{re}	Voltage Feedback Ratio	425	x10^{-6}	I_C = 1.0 mA V_{CE} = 5.0V
h_{fe}	Small Signal Current Gain	400		I_C = 1.0 mA V_{CE} = 5.0V
h_{ib}	Input Resistance	27	ohms	I_C = 1.0 mA V_{CB} = 5.0V

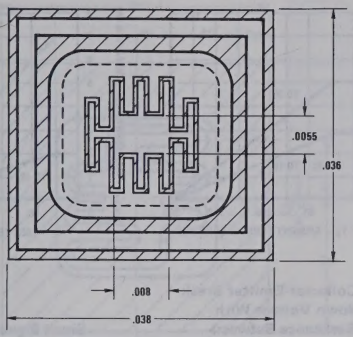
TYPICAL COMMON EMITTER CHARACTERISTICS (f = 1.0 kHz)







Process 08 NPN High Voltage



DESCRIPTION

Complements Process 73.

APPLICATION

This device was designed as a general purpose amplifier and switch for applications requiring high line voltages.

PRINCIPAL DEVICE TYPES:

TO-39 2N3501

OTHER DEVICE TYPES

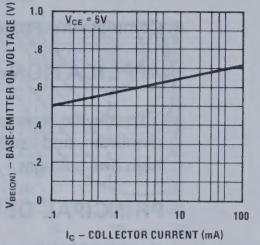
See pages 26 and 28.

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
BV_{CEO}	I_C at 10 mA	100	160		V	
BV_{CBO}	I_C at 10 μA	100	200		V	
BV_{EBO}	I_E at 10 μA	6	7.5		V	
I_{CBO}	V_{CB} at 50V			50	nA	
I_{EBO}	V_{EB} at 4V			25	nA	
H_{FE}	I_C at 0.1 mA, V_{CE} at 10V	20	40			
H_{FE}	I_C at 1 mA, V_{CE} at 10V	25	70			
H_{FE}	I_C at 10 mA, V_{CE} at 10V	35	95			
H_{FE}	I_C at 150 mA, V_{CE} at 10V	40	100	300		
H_{FE}	I_C at 300 mA, V_{CE} at 10V	15	40			
$V_{CE(SAT)}$	I_C at 150 mA, I_B at 15 mA		0.25	0.4	V	
$V_{BE(SAT)}$	I_C at 150 mA, I_B at 15 mA		0.9	1.2	V	
C_{OB}	V_{CB} at 10V		7.5	10	pF	
C_{IB}	V_{EB} at 0.5V		65	80	pF	
FT	I_C at 20 mA, V_{CE} at 20V, f at 100 MHz	150	200		MHz	

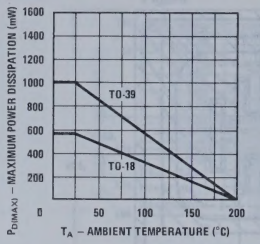
Process 08

DC Pulse Current Gain vs Collector Current

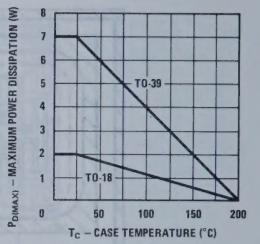
Base-Emitter On Voltage vs Collector Current



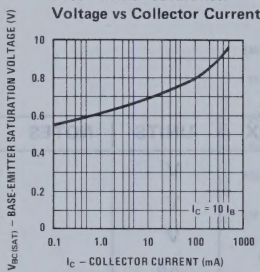
Maximum Power Dissipation vs Ambient Temperature



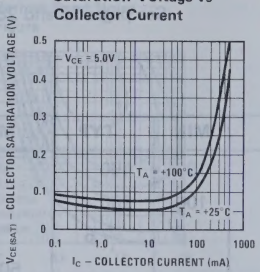
Maximum Power Dissipation vs Case Temperature



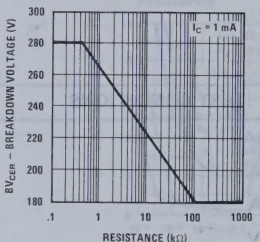
Base-Emitter Saturation Voltage vs Collector Current



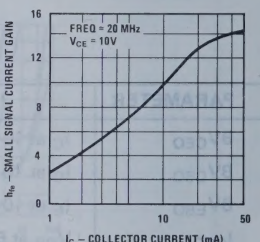
Collector-Emitter Saturation Voltage vs Collector Current



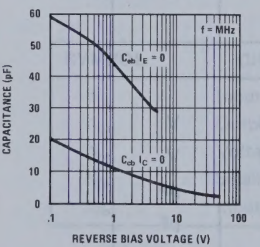
Collector-Emitter Breakdown Voltage With Resistance Between Emitter and Base



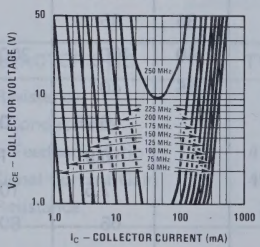
Small Signal Current Gain vs Collector Current



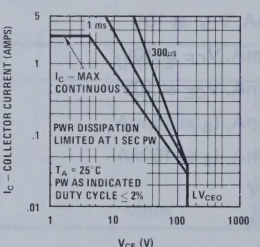
Input and Output Capacitance vs Reverse Bias Voltage



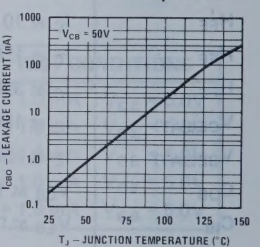
Collector-Emitter Voltage vs Collector Current



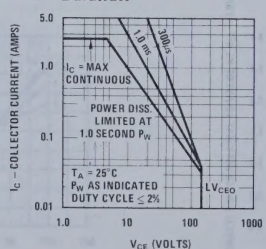
Safe Operating Area TO-39 With "Wake Field" Type 296-4 Heat Sink



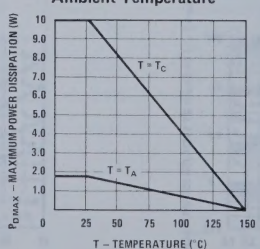
Collector-Base Diode Current vs Temperature



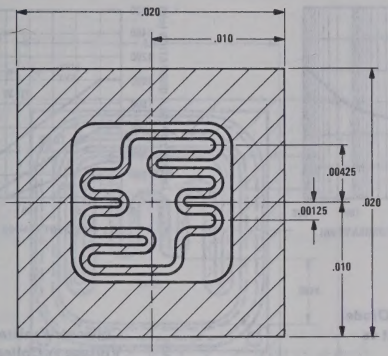
Safe Operating Area Durawatt



Maximum Power Dissipation Durawatt vs Case and Ambient Temperature



Process 09 NPN Medium Power



DESCRIPTION

Process 09 is a nonoverlay double diffused silicon epitaxial device.

APPLICATION

This device was designed for general purpose audio amplifier applications at collector currents to one Amp.

PRINCIPAL DEVICE TYPES:

TO-105 CS9013

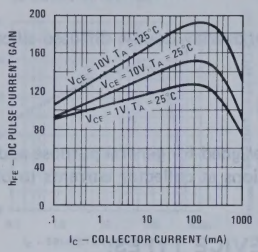
OTHER DEVICE TYPES

See page 23.

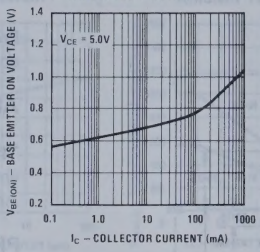
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
C_{OB}	V_{CB} = 10V		5	10	pF	
C_{IB}	V_{EB} = .5V		25	35	pF	
NF	V_{CE} = 10V, I_C = 1 mA		1.0		dB	
f_T	R_S = 1k, f = 1 kHz V_{CE} = 10V, I_C = 100 mA		400		MHz	
h_{FE}	V_{CE} = 1.0V, I_C = 1 mA	25	120	250		
h_{FE}	V_{CE} = 1.0V, I_C = 50 mA	40	130	350		
h_{FE}	V_{CE} = 1.0V, I_C = 500 mA	25	100	150		
h_{FE}	V_{CE} = 1.0V, I_C = 1A	15	80	100		
$V_{CE(SAT)}$	I_C = 150 mA, I_B = 15 mA		0.09		V	
$V_{CE(SAT)}$	I_C = 500 mA, I_B = 50 mA		0.24		V	
$V_{BE(SAT)}$	I_C = 150 mA, I_B = 15 mA		0.86		V	
$V_{BE(SAT)}$	I_C = 500 mA, I_B = 50 mA		1.0		V	
BV_{CBO}	I_C = 100 μA		100			
BV_{CEO}	I_C = 10 mA	25	30			
BV_{EBO}	I_E = 1 μA		7.5			
I_{CBO}	V_{CB} = 40V			50	nA	
I_{EBO}	V_{EB} = 4.0V			50	nA	

Process 09

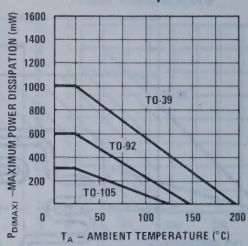
DC Pulse Current Gain vs Collector Current



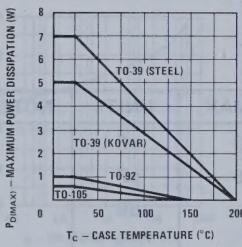
Base-Emitter On Voltage vs Collector Current



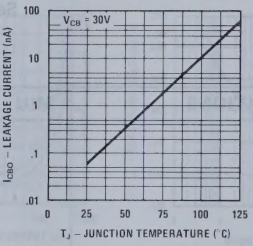
Maximum Power Dissipation vs Ambient Temperature



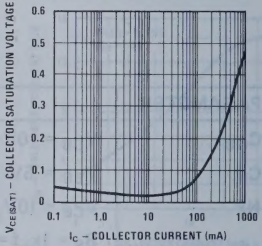
Maximum Power Dissipation vs Case Temperature



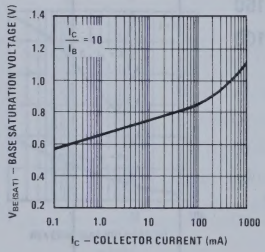
Collector-Base Diode Reverse Current vs Temperature



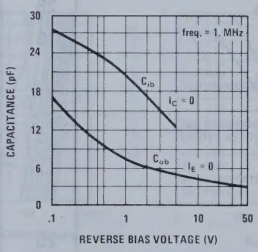
Collector-Emitter Saturation Voltage vs Collector Current



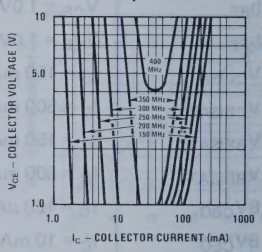
Base-Emitter Saturation Voltage vs Collector Current



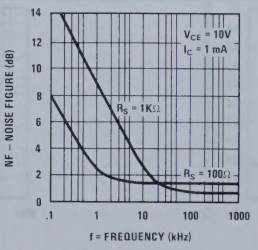
Capacitance vs Reverse Bias Voltage



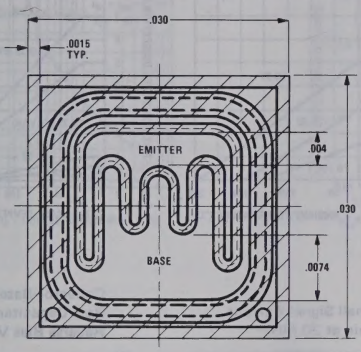
Contours of Constant Gain Bandwidth Product (f_T)



Noise Figure vs Frequency



Process 12 NPN Medium Power



DESCRIPTION

Process 12 is a nonoverlay, double diffused silicon epitaxial device. Complement to Process 67.

APPLICATION

This device was designed for general purpose medium power amplifiers and switches requiring collector currents up to 1 amp and collector voltages between 80 and 140 volts.

PRINCIPAL DEVICE TYPES:

TO-18	2N3700
TO-39	2N3019
TO-105	2N3568

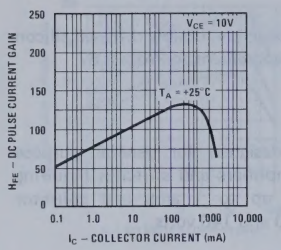
OTHER DEVICE TYPES

See pages 11, 20 through 23 and 27.

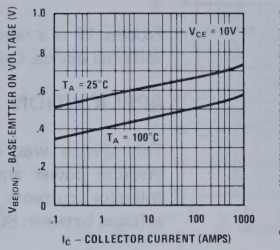
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
t_{on}	I_C = 150 mA, I_{B1} = 15 mA		50	60	ns	Fig. 1
t_{off}	I_C = 150 mA, I_{B2} = 15 mA		400	500	ns	
h_{fe}	I_C = 50 mA, V_{CE} = 10V, f = 20 MHz	4.0	6.5			
C_{cb}	V_{CB} = 10V		6.5	10	pF	TO-39
C_{eb}	V_{EB} = 0.5		50	60	pF	
NF	I_C = 100 μA, V_{CE} = 10V, R_S = 1k f = 1 kHz, PBW = 200 Hz		1.5	4	dB	
h_{FE}	I_C = 100 μA, V_{CE} = 10V	20	100			
h_{FE}	I_C = 1 mA, V_{CE} = 10V	20	130			
h_{FE}	I_C = 10 mA, V_{CE} = 10V	20	140			
h_{FE}	I_C = 100 mA, V_{CE} = 10V	20	160	400		
h_{FE}	I_C = 500 mA, V_{CE} = 10V	20	130			
h_{FE}	I_C = 1A, V_{CE} = 10V	20	40			
$V_{CE(SAT)}$	I_C = 100 mA, I_B = 10 mA		0.1	0.2	V	
$V_{CE(SAT)}$	I_C = 500 mA, I_B = 50 mA		0.35	0.5	V	
$V_{BE(SAT)}$	I_C = 100 mA, I_B = 10 mA		0.82	0.90	V	
$V_{BE(SAT)}$	I_C = 500 mA, I_B = 50 mA		1.0	1.20	V	
BV_{CEO}	I_C = 10 mA	80			V	
BV_{CBO}	I_C = 100 μA	140			V	
BV_{EBO}	I_C = 10 μA	7			V	
I_{CBO}	V_{CB} = 90V			50	nA	
I_{EBO}	V_{EB} = 5V			50	nA	

Process 12

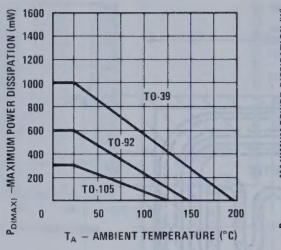
Pulsed DC Current Gain vs Collector Current



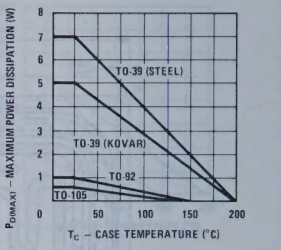
Base-Emitter On Voltage vs Collector Current



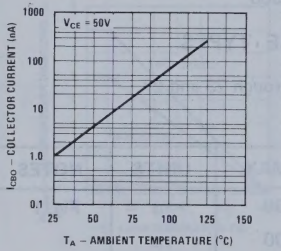
Maximum Power Dissipation vs Ambient Temperature



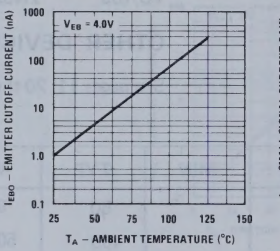
Maximum Power Dissipation vs Case Temperature



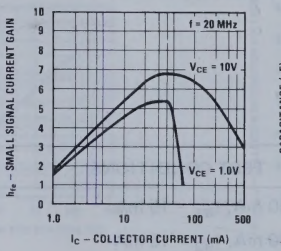
Collector Reverse Current vs Ambient Temperature



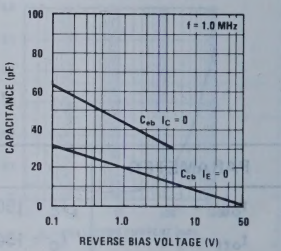
Emitter Cutoff Current vs Ambient Temperature



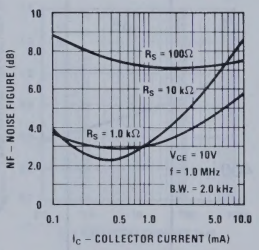
Small Signal Current Gain at 20 MHz



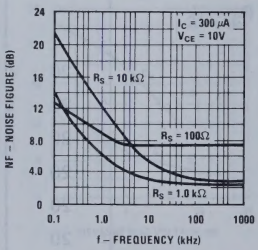
Collector-Base and Emitter Base Capacitance vs Reverse Bias Voltage



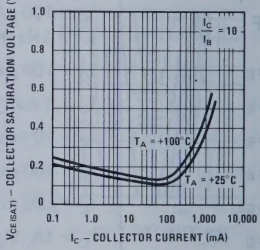
Noise Figure vs Collector Current



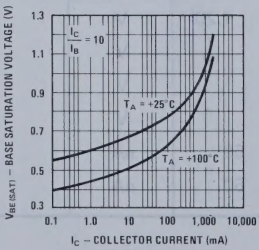
Noise Figure vs Frequency



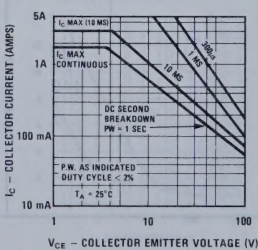
Collector Saturation Voltage vs Collector Current



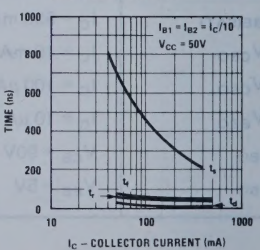
Base Saturation Voltage vs Collector Current



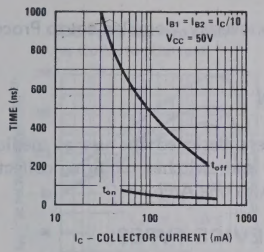
Safe Operating Area TO-39 With "Wake Field" Type 296-4 Heat Sink



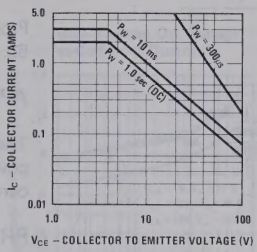
Switching Times vs Collector Current



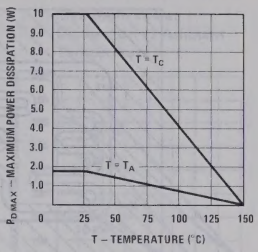
Turn On and Turn Off Times vs Collector Current

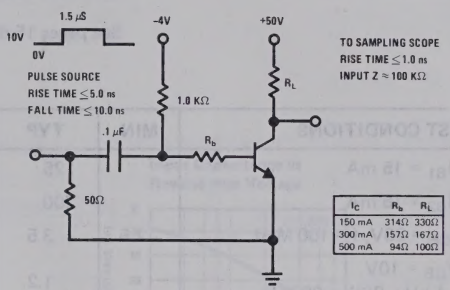


Safe Operating Area Durawatt



Maximum Power Dissipation Durawatt vs Case and Ambient Temperature





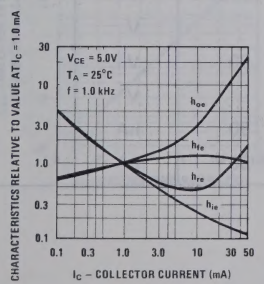
I_C	R_b	R_L
150 mA	314Ω	330Ω
300 mA	157Ω	167Ω
500 mA	94Ω	100Ω

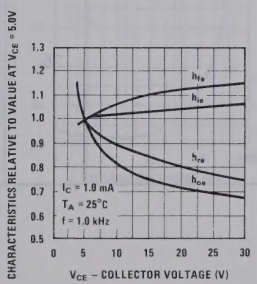
FIGURE 1. t_{on}, t_{off} Test Circuit

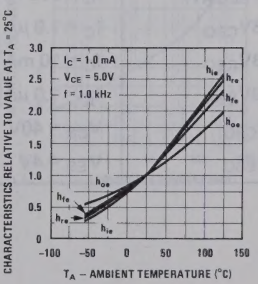
SMALL SIGNAL CHARACTERISTICS (f = 1.0 kHz)

SYMBOL	CHARACTERISTIC	TYP.	UNITS	TEST CONDITIONS	
h_{ie}	Input Resistance	3000	ohms	I_C = 1.0 mA	V_{CE} = 5.0V
h_{oe}	Output Conductance	8.0	μmhos	I_C = 1.0 mA	V_{CE} = 5.0V
h_{re}	Voltage Feedback Ratio	2.1	$x10^{-4}$	I_C = 1.0 mA	V_{CE} = 5.0V
h_{fe}	Small Signal Current Gain	100		I_C = 1.0 mA	V_{CE} = 5.0V

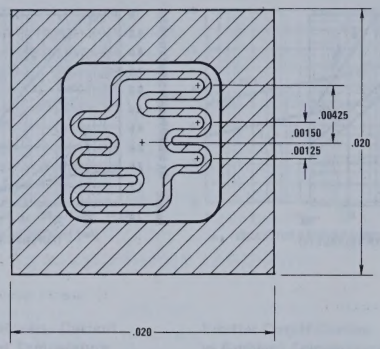
TYPICAL COMMON EMITTER CHARACTERISTICS (f = 1.0 kHz)







Process 13 NPN Medium Power



DESCRIPTION

Process 13 is a nonoverlay. Complement to Process 63.

APPLICATION

These devices were designed for use as medium power amplifiers and switches requiring collector currents of .1 mA to one Amp.

PRINCIPAL DEVICE TYPES:

TO-92 2N4401 (EBC), 2N3704 (ECB)

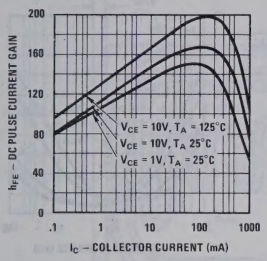
OTHER DEVICE TYPES

See pages 15 through 19.

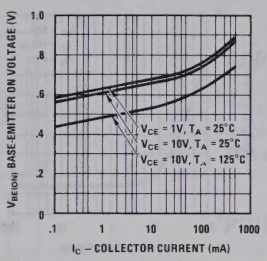
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
t_{on}	I_C = 150 mA, I_{B1} = 15 mA		25	35	ns	
t_{off}	I_C = 150 mA, I_{B2} = 15 mA		200	285	ns	
h_{fe}	I_C = 20 mA, V_{CE} = 20V, f = 100 MHz	2.5	3.5			
NF (spot)	I_C = 100 μA, V_{CE} = 10V R_S = 1 kΩ, f = 1 kHz, PBW = 200 Hz		1.2	4.0	dB	
C_{ob}	V_{CB} = 10 V		4.5		pF	
C_{ib}	V_{EB} = .5V		22		pF	
h_{FE}	V_{CE} = 1.0V, I_C = 100 μA	15	80	125		
h_{FE}	V_{CE} = 1.0V, I_C = 1.0 mA	25	110	200		
h_{FE}	V_{CE} = 1.0V, I_C = 10 mA	35	135	280		
h_{FE}	V_{CE} = 1.0V, I_C = 150 mA	40	140	300		
h_{FE}	V_{CE} = 1.0V, I_C = 500 mA	25	100	150		
h_{FE}	V_{CE} = 5.0V, I_C = 1A	15	45	60		
$V_{CE(SAT)}$	I_C = 150 mA, I_B = 15 mA		0.1	0.2	V	
$V_{CE(SAT)}$	I_C = 500 mA, I_B = 50 mA		0.26	0.36	V	
$V_{BE(SAT)}$	I_C = 150 mA, I_B = 15 mA		0.87	0.97	V	
$V_{BE(SAT)}$	I_C = 500 mA, I_B = 50 mA		1.0	1.2	V	
BV_{CBO}	I_C = 1.0 μA		110		V	
BV_{CEO}	I_C = 10 mA	35	45	50	V	
BV_{EBO}	I_E = 1.0 μA		7.5		V	
I_{CBO}	V_{CB} = 40V			50	nA	
I_{EBO}	V_{EB} = 4V			50	nA	

Process 13

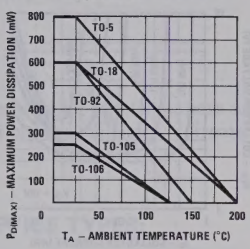
DC Pulse Current Gain vs Collector Current



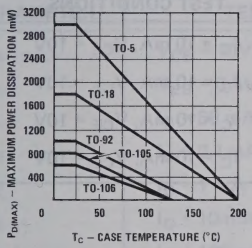
Base-Emitter On Voltage vs Collector Current



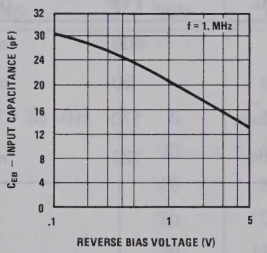
Maximum Power Dissipation vs Ambient Temperature



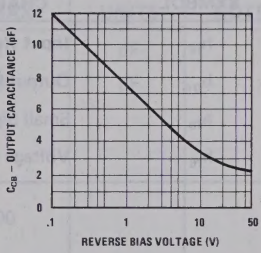
Maximum Power Dissipation vs Case Temperature



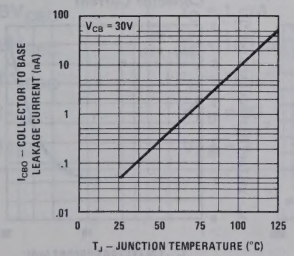
Input Capacitance vs Reverse Bias Voltage



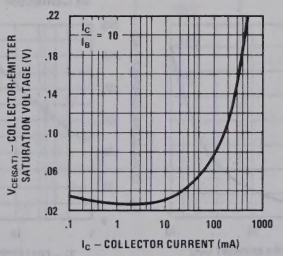
Output Capacitance vs Reverse Bias Voltage



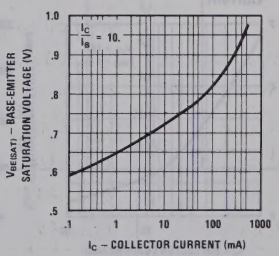
Collector to Base Diode Reverse Current vs Temperature



Collector-Emitter Saturation Voltage vs Collector Current

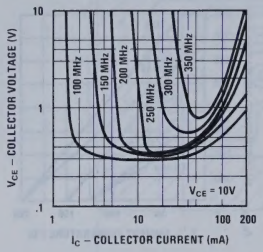


Base-Emitter Saturation Voltage vs Collector Current

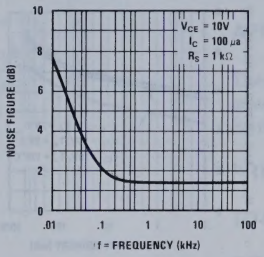


Process 13

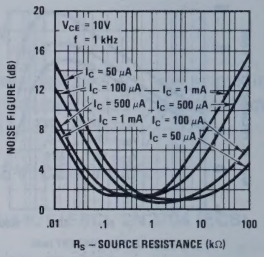
Contours of Constant Gain Bandwidth Product (f_t)



Noise Figure vs Frequency



Noise Figure vs Source Resistance

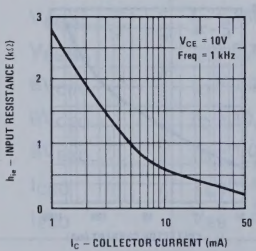


SMALL SIGNAL CHARACTERISTICS (f = 1.0 kHz)

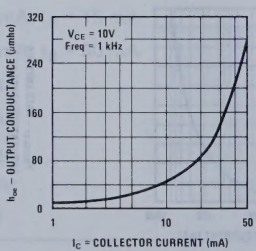
SYMBOL	CHARACTERISTIC	TYP	UNITS	TEST CONDITIONS
h_{ie}	Input Resistance	600	ohms	I_C = 10 mA, V_{CE} = 10V
h_{oe}	Output Conductance	50	μmhos	I_C = 10 mA, V_{CE} = 10V
h_{fe}	Small Signal Current Gain	170		I_C = 10 mA, V_{CE} = 10V
h_{re}	Voltage Feedback Ratio	120	$x10^{-6}$	I_C = 10 mA, V_{CE} = 10V

TYPICAL COMMON EMITTER CHARACTERISTICS (f = 1.0 kHz)

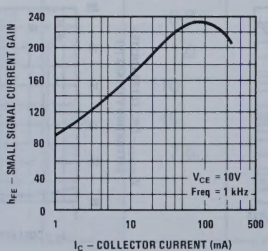
Small Signal Input Resistance vs Collector Current



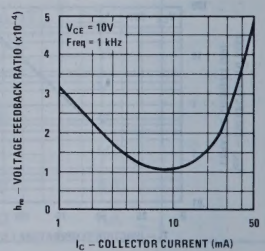
Small Signal Output Conductance vs Collector Current



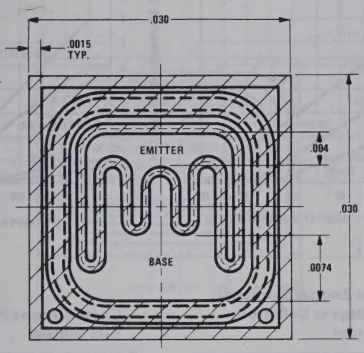
Small Signal Current Gain vs Collector Current



Small Signal Voltage Feedback Ratio vs Collector Current



Process 14 NPN Medium Power



DESCRIPTION

Process 14 is a nonoverlay double diffused silicon epitaxial device. Complement to Process 67.

APPLICATION

This device was designed for general purpose audio amplifier applications at collector currents to 500 mA.

PRINCIPAL DEVICE TYPES:

TO-39	BFY50
TO-92	MPS6560
TO-105	2N3569

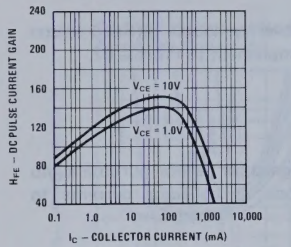
OTHER DEVICE TYPES

See pages 22, 23 and 17.

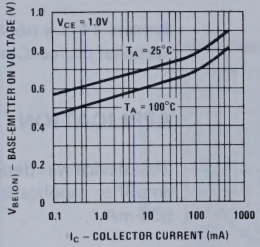
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
C_{ob}	V_{CB} = 10V		8	10	pF	
C_{ib}	V_{EB} = 0.5V		55	65	pF	
h_{fe}	I_C = 50 mA, V_{CE} = 10V, f = 20 MHz	5	10			
h_{FE}	I_C = 0.1 mA, V_{CE} = 1V	20	60			
h_{FE}	I_C = 1 mA	20	80			
h_{FE}	I_C = 10 mA	20	100	400		
h_{FE}	I_C = 100 mA	20	110			
h_{FE}	I_C = 500 mA	20	70			
$V_{CE(SAT)}$	I_C = 10 mA, I_B = 1 mA		0.04	0.10	V	
$V_{CE(SAT)}$	I_C = 100 mA, I_B = 10 mA		0.07	0.12	V	
$V_{BE(SAT)}$	I_C = 10 mA, I_B = 1 mA		0.70	0.90	V	
$V_{BE(SAT)}$	I_C = 100 mA, I_B = 10 mA		0.80	1.0	V	
BV_{CEO}	I_C = 1 mA	40			V	
BV_{CBO}	I_C = 100 μA	40			V	
BV_{EBO}	I_E = 10 μA	5			V	
I_{CBO}	V_{CB} = 30			50	nA	
I_{EBO}	V_{EB} = 3			50	nA	

Process 14

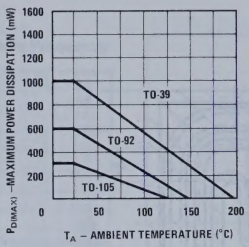
DC Pulse Current Gain vs Collector Current



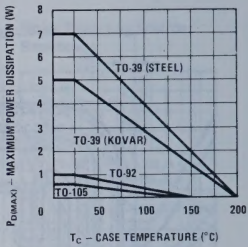
Base-Emitter On Voltage vs Collector Current



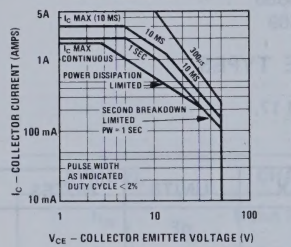
Maximum Power Dissipation vs Ambient Temperature



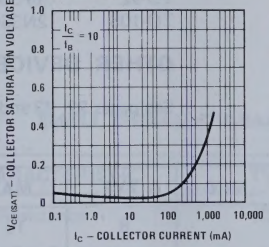
Maximum Power Dissipation vs Case Temperature



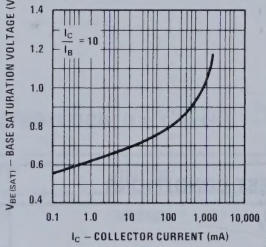
Safe Operating Area TO-39 With "Wake Field" Type 296-4 Heat Sink



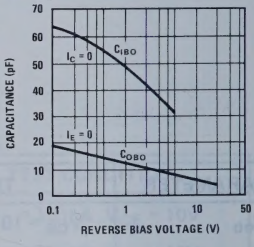
Collector-Emitter Saturation Voltage vs Collector Current



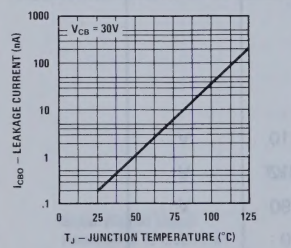
Base-Emitter Saturation Voltage vs Collector Current



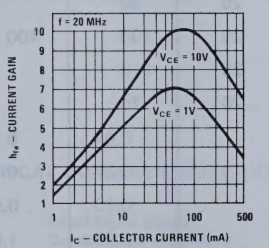
Capacitance vs Reverse Bias Voltage



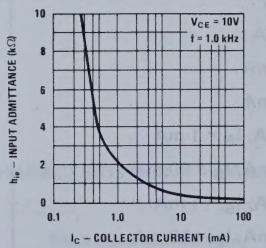
Collector-Base Diode Reverse Current vs Temperature



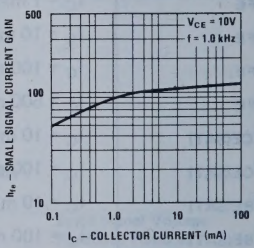
Small Signal Current Gain At 20 MHz vs Collector Current



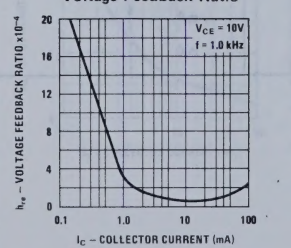
Input Admittance



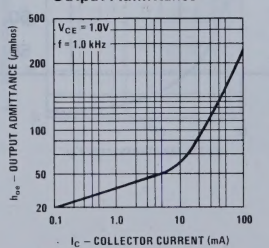
Small Signal Current Gain



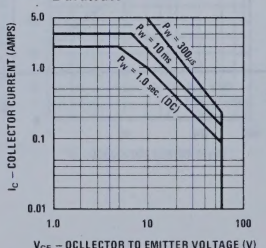
Voltage Feedback Ratio



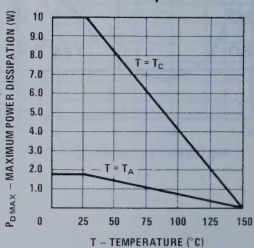
Output Admittance



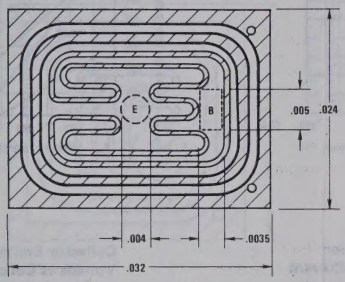
Safe Operating Area Durawatt



Maximum Power Dissipation Durawatt vs Case and Ambient Temperature



Process 15 NPN High Voltage



DESCRIPTION

Process 15 is a nonoverlay, double diffused, epitaxial silicon device.

APPLICATION

This device was designed for general purpose high voltage amplifiers and switches.

PRINCIPAL DEVICE TYPES:

TO-202	NSD127	TO-39	BF257
	NSD128		BF258
	NSD129		BF259

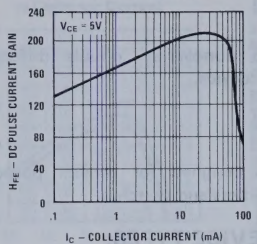
OTHER DEVICE TYPES

See pages 27 and 28.

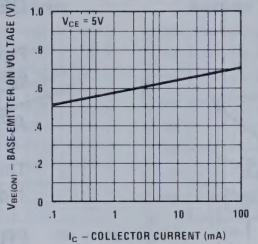
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
BV_{CEO}	I_C = 1 mA	100	250		V	
BV_{CBO}	I_C = 100 μA	120	250		V	
BV_{EBO}	I_E = 10 μA	5	7.2		V	
I_{CBO}	V_{CB} = 120V		0.5	50	nA	
I_{EBO}	V_{EB} = 4V		0.3	50	nA	
h_{FE}	I_C = 1 mA, V_{CE} = 5V	50	161			
h_{FE}	I_C = 10 mA, V_{CE} = 5V	50	200	500		
h_{FE}	I_C = 50 mA, V_{CE} = 5V	20	216			
$V_{CE(SAT)}$	I_C = 10 mA, I_B = 1 mA		0.068	0.15	V	
$V_{CE(SAT)}$	I_C = 50 mA, I_B = 5 mA		0.107	0.25	V	
$V_{BE(SAT)}$	I_C = 10 mA, I_B = 1 mA		0.698	1.0	V	
$V_{BE(SAT)}$	I_C = 50 mA, I_B = 10 mA		0.778	1.2	V	
f_T	I_C = 10 mA, V_{CE} = 10V, f = 100 MHz	100	172	500	MHz	
C_{ob}	V_{CB} = 10V		4.97	6	pF	
C_{cb}	V_{CB} = 10V		2.43	4	pF	
C_{ib}	V_{EB} = 0.5V		51	60	pF	

Process 15

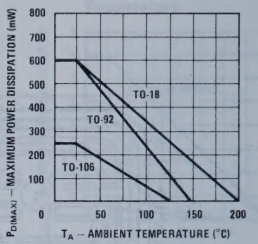
DC Pulse Current Gain vs Collector Current



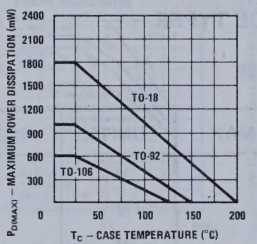
Base-Emitter on Voltage vs Collector Current



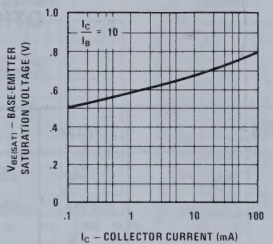
Maximum Power Dissipation vs Ambient Temperature



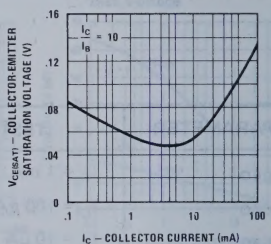
Maximum Power Dissipation vs Case Temperature



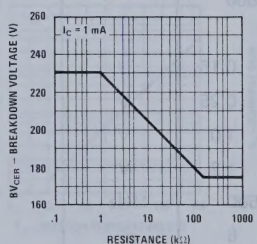
Base-Emitter Saturation Voltage vs Collector Current



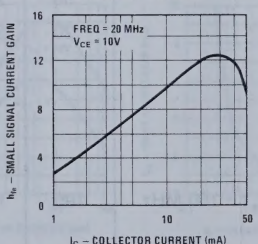
Collector-Emitter Saturation Voltage vs Collector Current



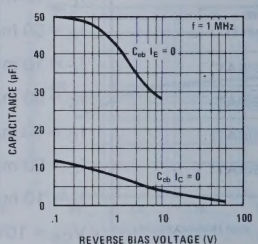
Collector-Emitter Breakdown Voltage With Resistance Between Emitter-Base



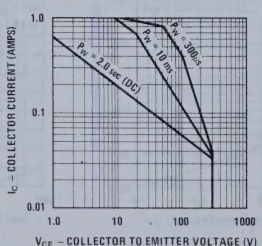
Small Signal Current Gain vs Collector Current



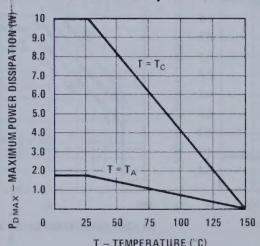
Input and Output Capacitance vs Reverse Bias Voltage



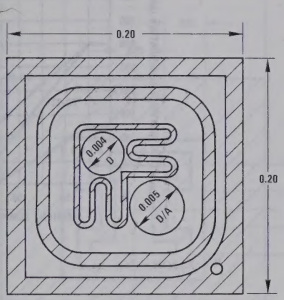
Safe Operating Area Durawatt



Maximum Power Dissipation Durawatt vs Case and Ambient Temperature



Process 16 NPN High Voltage



DESCRIPTION

Process 16 is a nonoverlay, double diffused, epitaxial silicon device.

APPLICATION

This device was designed for general purpose high voltage amplifiers and gas discharge display driving.

PRINCIPAL DEVICE TYPES:

TO-92 2N5551

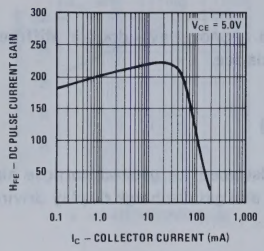
OTHER DEVICE TYPES

See page 27.

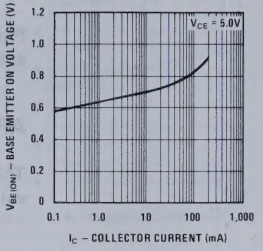
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
BV_{CEO}	I_C = 1.0 mA	100	170		V
BV_{CBO}	I_C = 100μA	120	275		V
BV_{EBO}	I_E = 10μA	5.0	7.2		V
I_{CBO}	V_{CB} = 120V		0.5	50	nA
I_{EBO}	V_{EB} = 4.0V		0.3	50	nA
h_{FE}	I_C = 1.0 mA, V_{CE} = 5.0V	50	100		
h_{FE}	I_C = 10 mA, V_{CE} = 5.0V	50	132	300	
h_{FE}	I_C = 50 mA, V_{CE} = 5.0V	20	60		
$V_{CE(SAT)}$	I_C = 10 mA, I_B = 1.0 mA		0.064	0.15	V
$V_{CE(SAT)}$	I_C = 50 mA, I_B = 5.0 mA		0.115	0.25	V
$V_{BE(SAT)}$	I_C = 10 mA, I_B = 1.0 mA		0.743	1.0	V
$V_{BE(SAT)}$	I_C = 50 mA, I_B = 10 mA		0.825	1.2	V
f_T	I_C = 10 mA, V_{CE} = 10V, f = 100 MHz	100	220	300	MHz
C_{ob}	V_{CB} = 10V		2.67	6.0	pF
C_{cb}	V_{CB} = 10V		2.53	4.0	pF
C_{ib}	V_{EB} = 0.5V		1.5	30	pF

Process 16

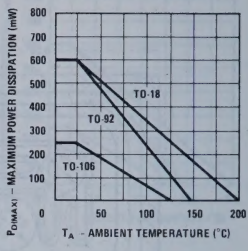
DC Pulse Current Gain vs Collector Current



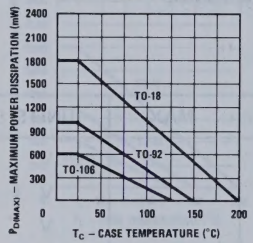
Base-Emitter on Voltage vs Collector Current



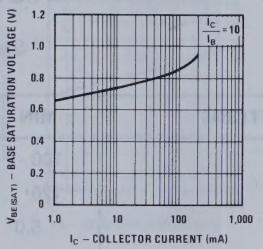
Maximum Power Dissipation vs Ambient Temperature



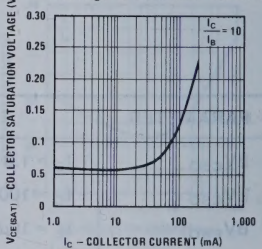
Maximum Power Dissipation vs Case Temperature



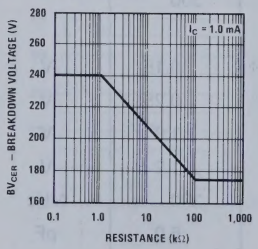
Base-Emitter Saturation Voltage vs Collector Current



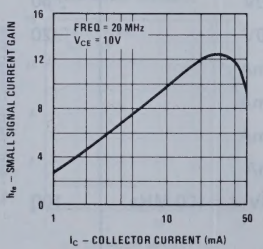
Collector-Emitter Saturation Voltage vs Collector Current



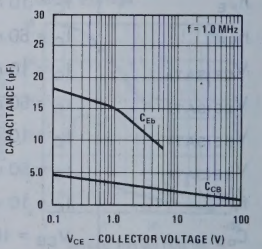
Collector-Emitter Breakdown Voltage With Resistance Between Emitter-Base



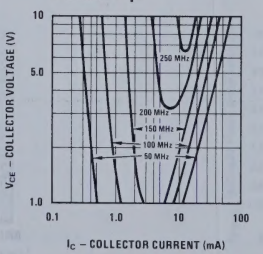
Small Signal Current Gain vs Collector Current



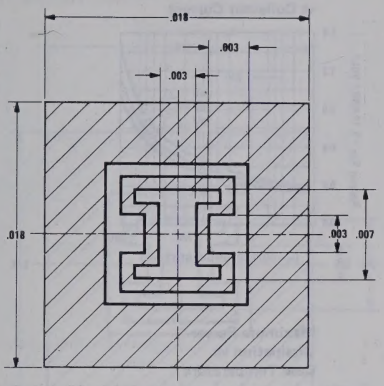
Input and Output Capacitance vs Reverse Bias Voltage



Contours of Constant Gain Bandwidth Product (f_T)



Process 19 NPN Medium Power



DESCRIPTION

Process 19 is nonoverlay double diffused, gold doped, silicon epitaxial device. Complement to Process 63.

APPLICATION

These devices were designed for use as medium power amplifiers and switches requiring collector currents of 0.1 to 500 mA.

PRINCIPAL DEVICE TYPES:

TO-92 2N4401

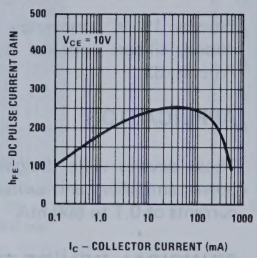
OTHER DEVICE TYPES

See pages 15, 17 and 19.

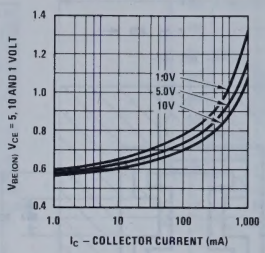
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
t_{on}	I_C = 150 mA, I_{B1} = 15 mA		25	35	ns	
t_{off}	I_C = 150 mA, I_{B2} = 15 mA		200	285	ns	
h_{fe}	I_C = 20 mA, V_{CE} = 20V, f = 100 MHz	2.5	3.5			
C_{cb}	V_{CB} = 10V		3.0	6.0	pF	
C_{cb}	V_{EB} = 0.5V		18	25	pF	
NF (spot)	I_C = 100 μA, V_{CE} = 10V R_S = 1 kΩ, f = 1 kHz, PBW = 200 Hz		1.2	4.0	dB	
h_{FE}	I_C = 100 μA, V_{CE} = 10V	20	100			
h_{FE}	I_C = 1 mA, V_{CE} = 10V	20	195			
h_{FE}	I_C = 10 mA	20	240	500		
h_{FE}	I_C = 100 mA	20	250	500		
h_{FE}	I_C = 500 mA	20	90			
h_{FE}	I_C = 1A	15	30			
$V_{CE(SAT)}$	I_C = 100 mA, I_B = 10 mA		0.12	0.50	V	
$V_{CE(SAT)}$	I_C = 500 mA, I_B = 50 mA		0.35	1.0	V	
$V_{BE(SAT)}$	I_C = 100 mA, I_B = 10 mA		0.90	1.2	V	
$V_{BE(SAT)}$	I_C = 500 mA, I_B = 50 mA		1.00	1.5	V	
BV_{CEO}	I_C = 10 mA	40			V	
BV_{CBO}	I_C = 100 μA	70			V	
BV_{EBO}	I_E = 10 μA	6			V	
I_{CBO}	V_{CB} = 60V			50	nA	
I_{EBO}	V_{EB} = 3V			50	nA	

Process 19

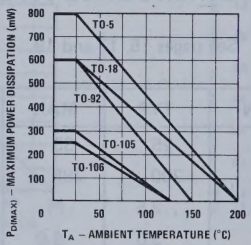
DC Pulse Current Gain vs Collector Current



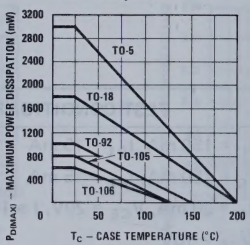
Base-Emitter On Voltage vs Collector Current



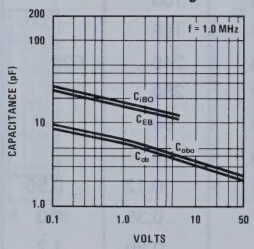
Maximum Power Dissipation vs Ambient Temperature



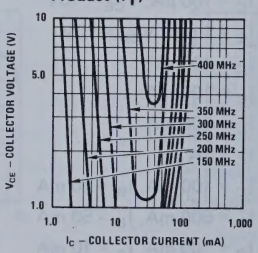
Maximum Power Dissipation vs Case Temperature



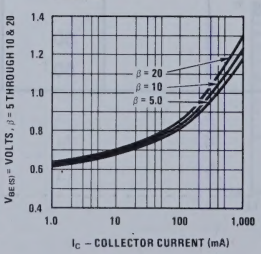
Emitter Transition and Output Capacitance vs Reverse Bias Voltage



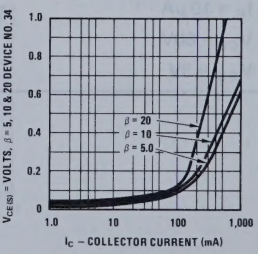
Contours of Constant Gain Bandwidth Product (f_T)



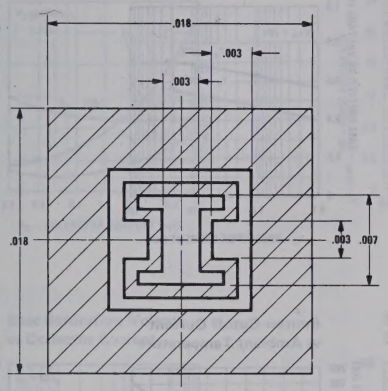
Base-Emitter Saturation Voltage vs Collector Current



Collector-Emitter Saturation Voltage vs Collector Current



Process 20 NPN Medium Power



DESCRIPTION

Process 20 is nonoverlay double diffused, gold doped, silicon epitaxial device. Complement to Process 63.

APPLICATION

These devices were designed for use as medium power amplifiers and switches requiring collector currents of 0.1 to 500 mA.

PRINCIPAL DEVICE TYPES:

TO-15	2N2219A
TO-18	2N2222A
TO-92	MPS3642
TO-105	2N3643
TO-106	2N4141

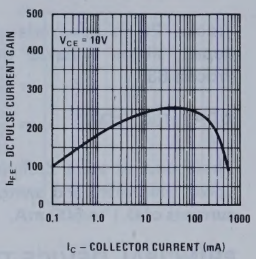
OTHER DEVICE TYPES

See pages 11 through 19

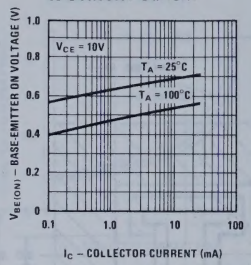
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
t_{on}	I_C = 150 mA, I_{B1} = 15 mA		25	35	ns	
t_{off}	I_C = 150 mA, I_{B2} = 15 mA		200	285	ns	
h_{fe}	I_C = 20 mA, V_{CE} = 20V, f = 100 MHz	2.5	3.5			
C_{cb}	V_{CB} = 10V		3.0	6.0	pF	
C_{cb}	V_{EB} = 0.5V		18	25	pF	
NF (spot)	I_C = 100 μA, V_{CE} = 10V R_S = 1 kΩ, f = 1 kHz, PBW = 200 Hz		1.2	4.0	dB	
h_{FE}	I_C = 100 μA, V_{CE} = 10V	20	100			
h_{FE}	I_C = 1 mA, V_{CE} = 10V	20	195			
h_{FE}	I_C = 10 mA	20	240	500		
h_{FE}	I_C = 100 mA	20	250	500		
h_{FE}	I_C = 500 mA	20	90			
h_{FE}	I_C = 1A	15	30			
$V_{CE(SAT)}$	I_C = 100 mA, I_B = 10 mA		0.12	0.50	V	
$V_{CE(SAT)}$	I_C = 500 mA, I_B = 50 mA		0.35	1.0	V	
$V_{BE(SAT)}$	I_C = 100 mA, I_B = 10 mA		0.90	1.2	V	
$V_{BE(SAT)}$	I_C = 500 mA, I_B = 50 mA		1.00	1.5	V	
BV_{CEO}	I_C = 10 mA	40			V	
BV_{CBO}	I_C = 100 μA	70			V	
BV_{EBO}	I_E = 10 μA	6			V	
I_{CBO}	V_{CB} = 60V			50	nA	
I_{EBO}	V_{EB} = 3V			50	nA	

Process 20

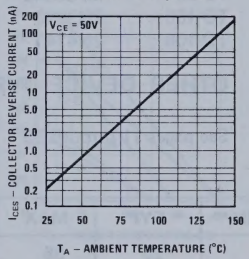
DC Pulse Current Gain vs Collector Current



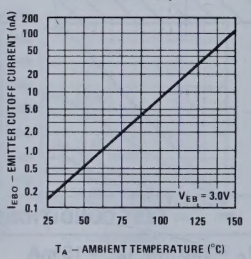
Base-Emitter On Voltage vs Collector Current



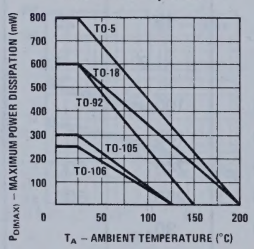
Collector Reverse Current vs Ambient Temperature



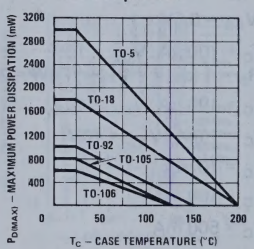
Emitter Cutoff Current vs Ambient Temperature



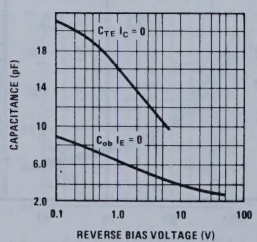
Maximum Power Dissipation vs Ambient Temperature



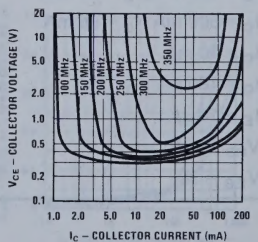
Maximum Power Dissipation vs Case Temperature



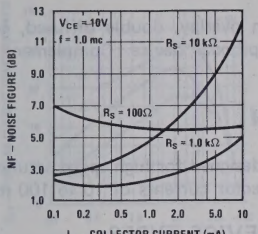
Emitter Transition and Output Capacitance vs Reverse Bias Voltage



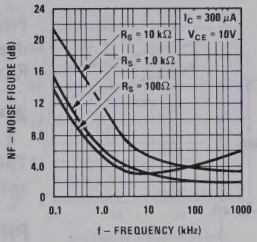
Contours of Constant Gain Bandwidth Product (f_T)



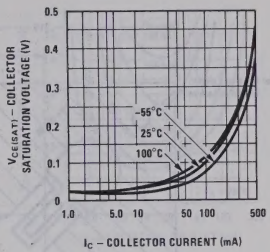
Noise Figure vs Collector Current



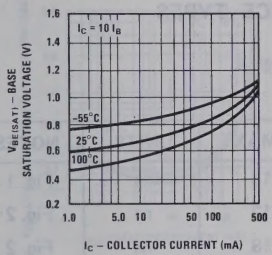
Noise Figure vs Frequency



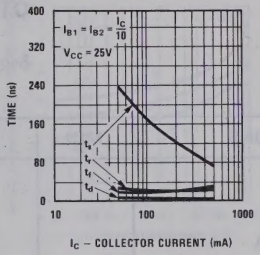
Collector Saturation Voltage vs Collector Current



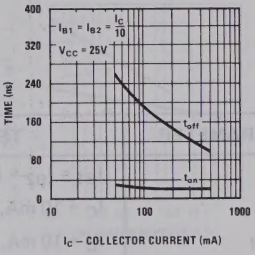
Base Saturation Voltage vs Collector Current



Switching Times vs Collector Current



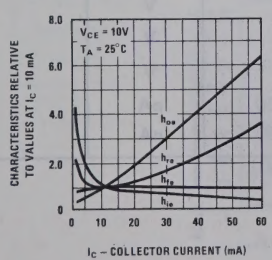
Turn On and Turn Off Times vs Collector Current

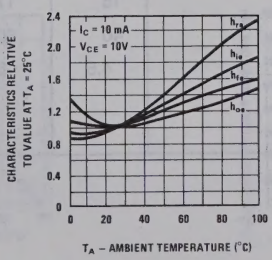


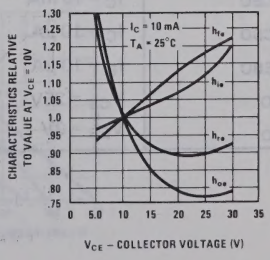
SMALL SIGNAL CHARACTERISTICS (f = 1.0 kHz)

SYMBOL	CHARACTERISTIC	TYP.	UNITS	TEST CONDITIONS
h_{ie}	Input Resistance	700	ohms	I_C = 10 mA V_{CE} = 10V
h_{oe}	Output Conductance	120	μmhos	I_C = 10 mA V_{CE} = 10V
h_{fe}	Small Signal Current Gain	240		I_C = 10 mA V_{CE} = 10V
h_{re}	Voltage Feedback Ratio	460	x10^{-6}	I_C = 10 mA V_{CE} = 10V

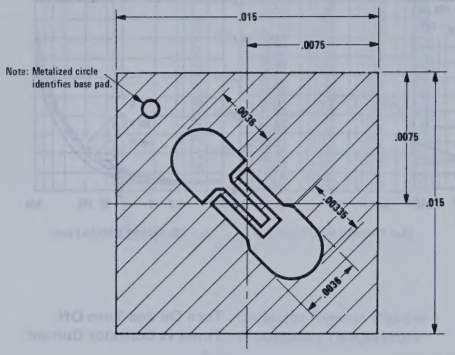
TYPICAL COMMON EMITTER CHARACTERISTICS (f = 1.0 kHz)







Process 21 NPN High Speed Switch



DESCRIPTION

Process 21 is an overlay, double diffused, gold doped silicon epitaxial device. Complement to Process 65.

APPLICATION

This device was designed for high speed saturated switching at collector currents of 10 to 100 mA.

PRINCIPAL DEVICE TYPES:

TO-18	2N2369A
TO-92	MPS2369 (EBC), 2N5030 (ECB)
TO-106	2N4275

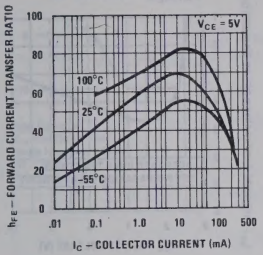
OTHER DEVICE TYPES

See pages 1 through 4

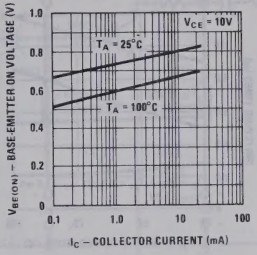
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
t_s	$I_{B1} = I_{B2} = I_C = 10$ mA		7	13	ns	Fig. 1
t_{on}	$I_C = 10$ mA, $I_{B1} = 3$ mA		9	12	ns	Fig. 2
t_{off}	$I_C = 10$ mA, $I_{B2} = 1.50$ mA		10	18	ns	Fig. 2
h_{fe}	$I_C = 10$ mA, $V_{CE} = 10$V, f = 100 MHz	5.0	7.0			
C_{cb}	$V_{CB} = 5$V		2.0	4.0	pF	TO-18
C_{EB}	$V_{EB} = 0.5$V		4.0	5.0	pF	TO-18
h_{FE}	$I_C = 1$ mA, $V_{CE} = 1$V	40	70	200		
h_{FE}	$I_C = 10$ mA, $V_{CE} = 1$V	40	70	200		
h_{FE}	$I_C = 50$ mA, $V_{CE} = 1$V	40	60	200		
h_{FE}	$I_C = 100$ mA, $V_{CE} = 1$V	40	50	200		
h_{FE}	$I_C = 10$ mA, $V_{CE} = 0.35$V	40	65	200		
h_{FE}	$I_C = 30$ mA, $V_{CE} = 0.4$V	40	60	200		
$V_{CE(SAT)}$	$I_C = 10$ mA, $I_B = 1$ mA		0.14	0.2	V	
$V_{CE(SAT)}$	$I_C = 100$ mA, $I_B = 10$ mA		0.20	0.5	V	
$V_{BE(SAT)}$	$I_C = 10$ mA, $I_B = 1$ mA		0.80	0.85	V	
$V_{BE(SAT)}$	$I_C = 100$ mA, $I_B = 10$ mA		1.0	1.5	V	
BV_{CEO}	$I_C = 10$ mA	15	17		V	
BV_{CBO}	$I_C = 10\,\mu$A	40	60		V	
BV_{EBO}	$I_E = 10\,\mu$A	4.5	5.5		V	
I_{CBO}	$V_{CB} = 25$V			50	nA	
I_{EBO}	$V_{EB} = 3$V			50	nA	

Process 21

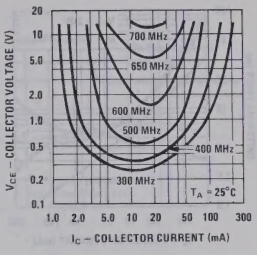
Pulse DC Current Gain vs Collector Current



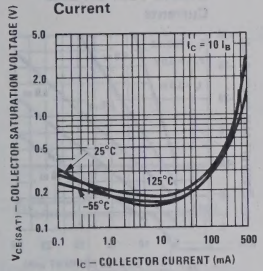
Base-Emitter On Voltage vs Collector Current



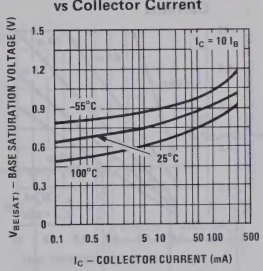
Contours of Constant Gain Bandwidth Product (f_T)



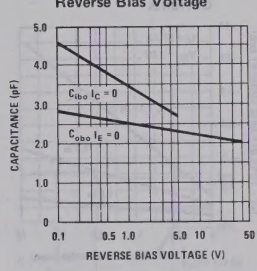
Collector Saturation Voltage vs Collector Current



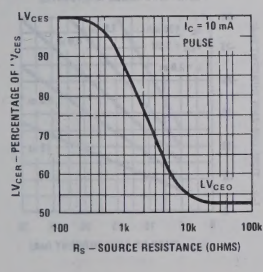
Base Saturation Voltage vs Collector Current



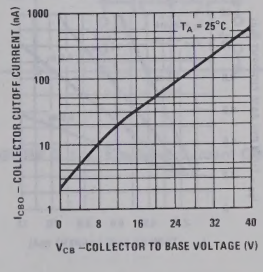
Emitter Transition and Output Capacitances vs Reverse Bias Voltage



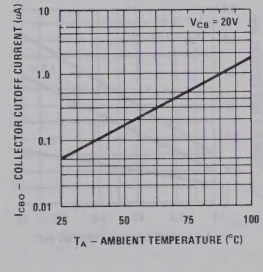
Lower Limiting Voltage vs Source Resistance



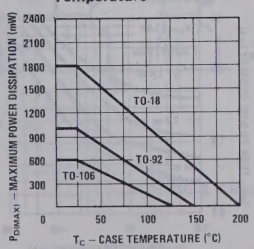
Collector Cutoff Current vs Reverse Bias Voltage



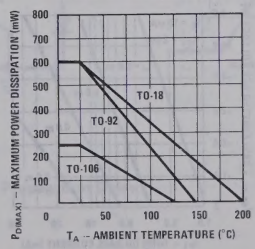
Collector Cutoff Current vs Ambient Temperature



Maximum Power Dissipation vs Case Temperature

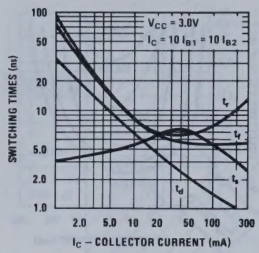


Maximum Power Dissipation vs Ambient Temperature

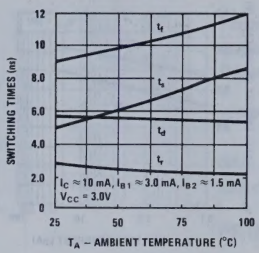


Process 21

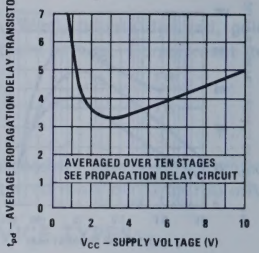
Switching Times vs Collector Current



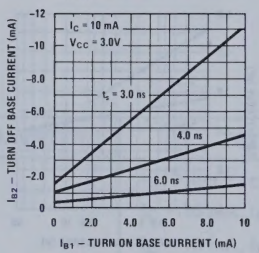
Switching Times vs Ambient Temperature



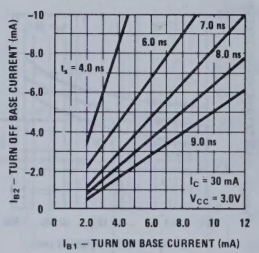
Average Propagation Delay Per Transistor vs Collector Voltage



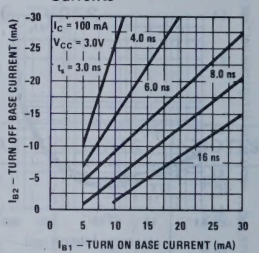
Storage Time vs Turn On and Turn Off Base Currents



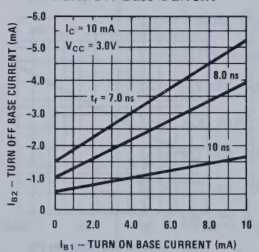
Storage Time vs Turn On and Turn Off Base Currents



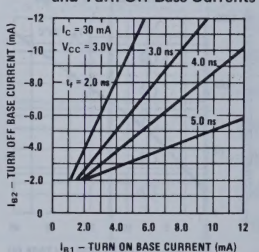
Storage Time vs Turn On and Turn Off Base Currents



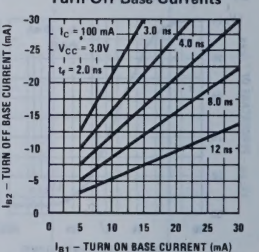
Fall Time vs Turn On and Turn Off Base Current



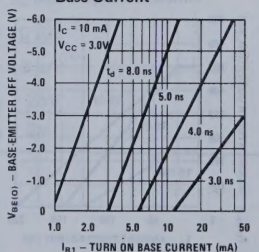
Fall Time vs Turn On and Turn Off Base Currents



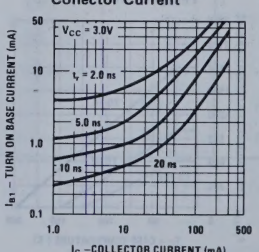
Fall Time vs Turn On and Turn Off Base Currents



Delay Time vs Base Emitter Off Voltage and Turn On Base Current



Rise Time vs Turn On Base Current and Collector Current



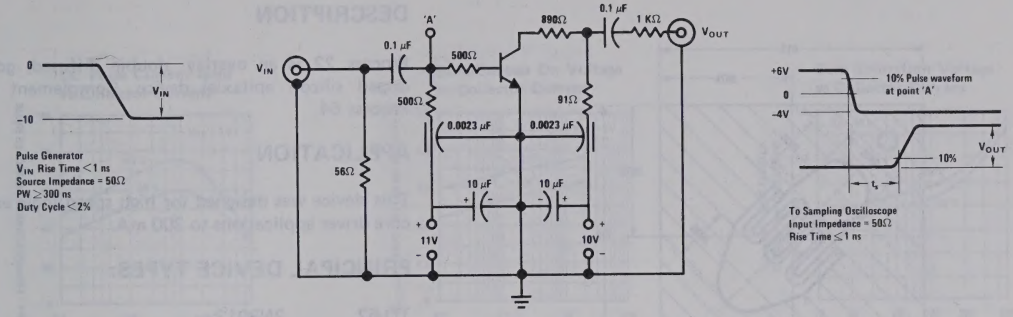


FIGURE 1. Charge Storage Time Measurement Circuit

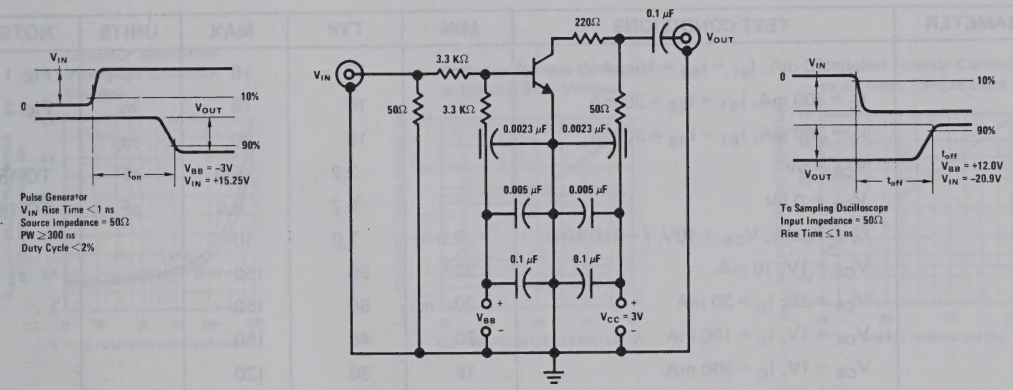
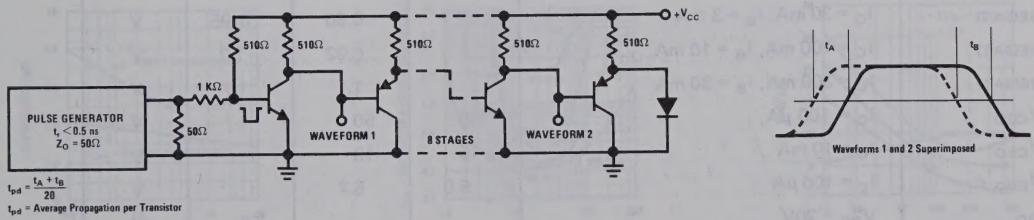


FIGURE 2. t_{on}, t_{off} Measurement Circuit

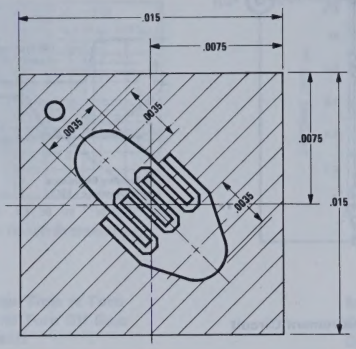


$t_{pd} = \frac{t_A + t_B}{28}$

t_{pd} = Average Propagation per Transistor

FIGURE 3. Circuit For Measurement of Propagation Delay

Process 22 NPN Small Signal



DESCRIPTION

Process 22 is an overlay, double diffused, gold doped silicon epitaxial device. Complement to Process 64.

APPLICATION

This device was designed for high speed logic and core driver applications to 300 mA.

PRINCIPAL DEVICE TYPES:

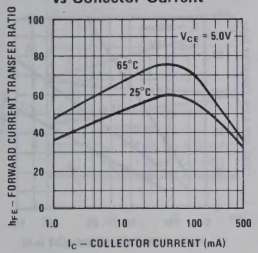
TO-52	2N3013
TO-92	MPS3646
TO-106	2N3646

OTHER DEVICE TYPES

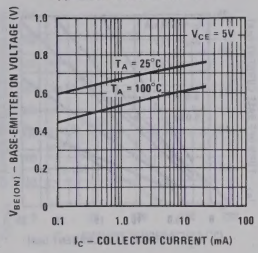
See pages 1 and 4.

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
t_s	I_C = 10 mA, I_{B1} = I_{B2} = 10 mA		12	18	ns	Fig. 1
t_{on}	I_C = 300 mA, I_{B1} = I_{B2} = 30 mA		10	18	ns	Fig. 2
t_{off}	I_C = 300 mA, I_{B1} = I_{B2} = 30 mA		18	30	ns	
C_{ob}	V_{CB} = 5V		3.2	5.0	pF	TO-18
C_{ob}	V_{EB} = 0.5V		6.2	8.0	pF	TO-18
h_{fe}	I_C = 30 mA, V_{CE} = 10V, f = 100 MHz	3.5	7.0	10		
h_{FE}	V_{CE} = 1V, 10 mA	20	50	150		
h_{FE}	V_{CE} = 1V, I_C = 30 mA	20	50	150		
h_{FE}	V_{CE} = 1V, I_C = 100 mA	20	48	150		
h_{FE}	V_{CE} = 1V, I_C = 300 mA	15	30	120		
h_{FE}	V_{CE} = 0.4V, I_C = 30 mA	20	50	150		
h_{FE}	V_{CE} = 0.5V, I_C = 100 mA	20	50	150		
$V_{CE(SAT)}$	I_C = 30 mA, I_B = 3 mA		0.14	0.20	V	
$V_{CE(SAT)}$	I_C = 100 mA, I_B = 10 mA		0.20	0.28	V	
$V_{CE(SAT)}$	I_C = 300 mA, I_B = 30 mA		0.40	0.50	V	
$V_{BE(SAT)}$	I_C = 30 mA, I_B = 3 mA		0.80	0.95	V	
$V_{BE(SAT)}$	I_C = 100 mA, I_B = 10 mA		0.92	1.2	V	
$V_{BE(SAT)}$	I_C = 300 mA, I_B = 30 mA		1.1	1.7	V	
BV_{CBO}	I_C = 100 μA	40	50		V	
BV_{CEO}	I_C = 10 mA	15	18		V	
BV_{EBO}	I_E = 100 μA	5.0	5.7		V	
I_{CBO}	V_{CB} = 20V			50	nA	
I_{EBO}	V_{EB} = 3V			50	nA	

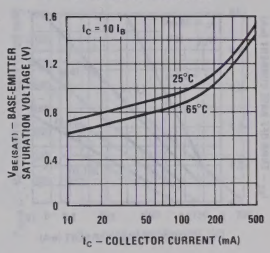
DC Pulse Current Gain vs Collector Current



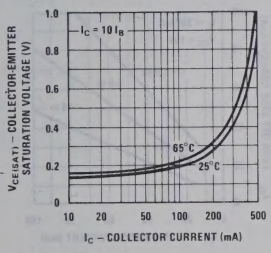
Base-Emitter On Voltage vs Collector Current



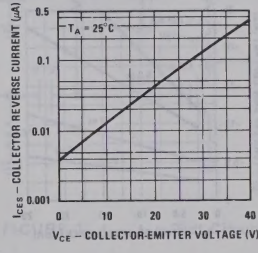
Base Saturation Voltage vs Collector Current



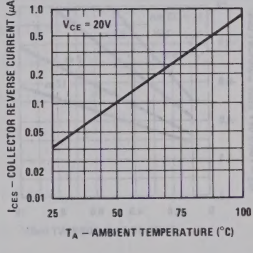
Collector Saturation Voltage vs Collector Current



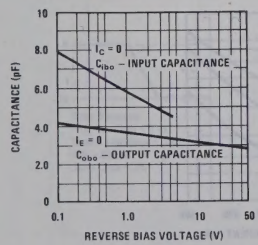
Collector Reverse Current vs Reverse Bias Voltage



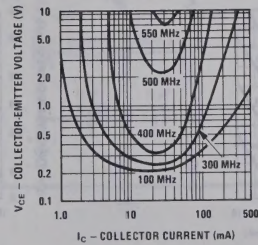
Collector Reverse Current vs Ambient Temperature



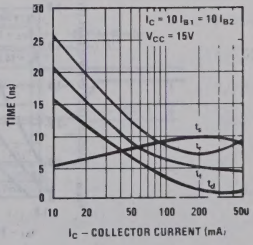
Input and Output Capacitance vs Reverse Bias Voltage



Contours of Constant Gain Bandwidth Product (f_T)

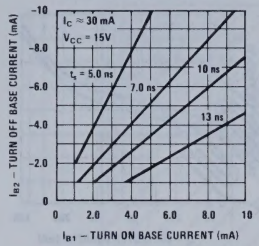


Switching Times vs Collector Current

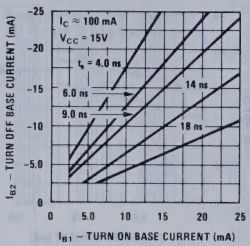


Process 22

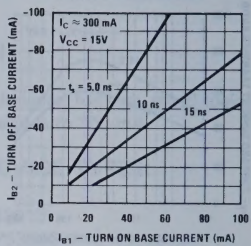
Storage Time vs Turn On and Turn Off Base Currents



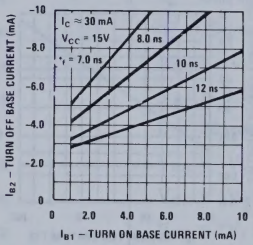
Storage Time vs Turn On and Turn Off Base Currents



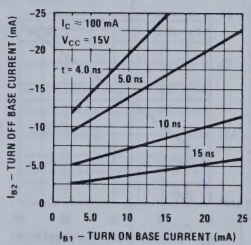
Storage Time vs Turn On and Turn Off Base Currents



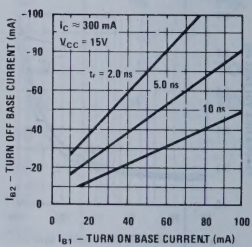
Fall Time vs Turn On and Turn Off Base Currents



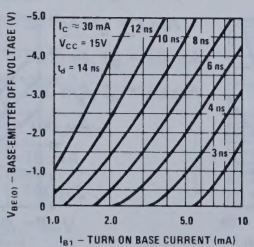
Fall Time vs Turn On and Turn Off Base Currents



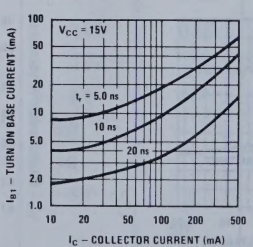
Fall Time vs Turn On and Turn Off Base Currents



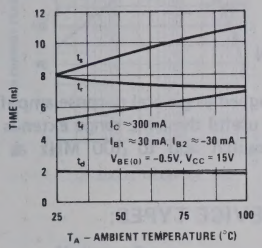
Delay Time vs Base Emitter Off Voltage and Turn On Base Current



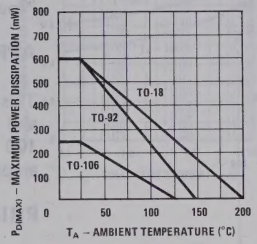
Rise Time vs Collector and Turn On Base Currents



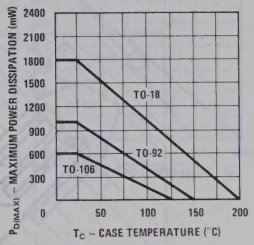
Switching Times vs Ambient Temperature



Maximum Power Dissipation vs Ambient Temperature



Maximum Power Dissipation vs Case Temperature



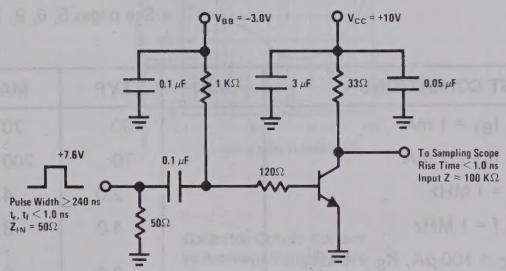


FIGURE 1. t_{on}, t_{off} Test Circuit

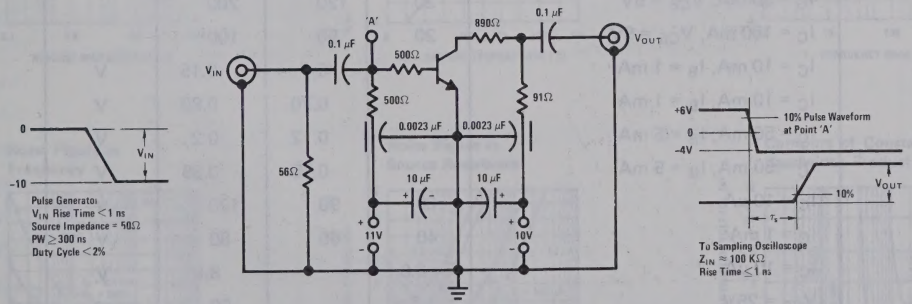
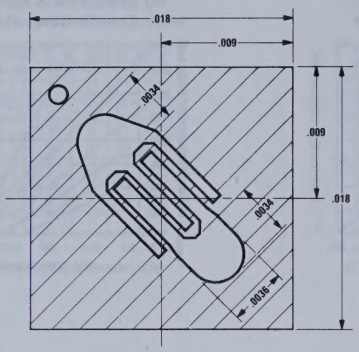


FIGURE 2. Charge Storage Time Measurement Circuit

Process 23 NPN Small Signal



DESCRIPTION

Process 23 is an overlay, double diffused gold doped silicon epitaxial device. Complement to Process 66.

APPLICATION

This device is designed as general purpose amplifier and switch. The useful dynamic range extends to 100 mA as a switch and to 100 MHz as an amplifier.

PRINCIPAL DEVICE TYPES:

TO-18	NS3904
TO-92	2N3904
TO-106	SM3904

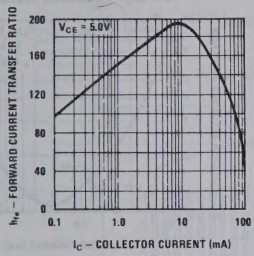
OTHER DEVICE TYPES

See pages 5, 6, 9, 10, 12, 16, 18 and 19.

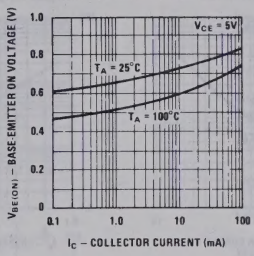
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
t_{on}	I_C = 10 mA, I_{B1} = 1 mA		30	70	ns	Fig. 1
t_{off}	I_C = 10 mA, I_{B2} = 1 mA		70	200	ns	Fig. 2
C_{ob}	V_{CB} = 5V, f = 1 MHz		2.0	4.0	pF	TO-18
C_{ib}	V_{EB} = 0.5V, f = 1 MHz		4.0	8.0	pF	TO-18
NF	V_{CE} = 5V, I_C = 100 μA, R_S = 1 kΩ, P_{BW} = 15.7 kHz		2.0	5.0	dB	
h_{fe}	I_C = 10 mA, V_{CE} = 20V, f = 100 MHz	2.0	5.0	7.0		
H_{FE}	I_C = 100 μA, V_{CE} = 5V	40	100	300		
H_{FE}	I_C = 1 mA, V_{CE} = 5V	70	150	300		
H_{FE}	I_C = 10 mA, V_{CE} = 5V	60	200	350		
H_{FE}	I_C = 50 mA, V_{CE} = 5V	30	120	200		
H_{FE}	I_C = 100 mA, V_{CE} = 5V	20	50	100		
$V_{CE(SAT)}$	I_C = 10 mA, I_B = 1 mA		0.1	0.15	V	
$V_{BE(SAT)}$	I_C = 10 mA, I_B = 1 mA		0.70	0.80	V	
$V_{CE(SAT)}$	I_C = 50 mA, I_B = 5 mA		0.12	0.2	V	
$V_{BE(SAT)}$	I_C = 50 mA, I_B = 5 mA		0.75	0.85	V	
BV_{CBO}	I_C = 10 μA	60	90	120	V	
BV_{CEO}	I_C = 1 mA	40	60	80	V	
BV_{EBO}	I_C = 10 μA	6.0		8.0	V	
I_{CBO}	V_{CB} = 25V			50	nA	
I_{EBO}	V_{EB} = 4V			50	nA	

Process 23

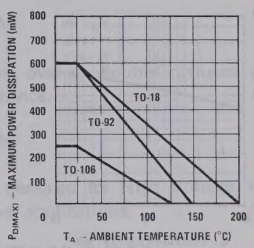
Pulsed DC Current Gain vs Collector Current



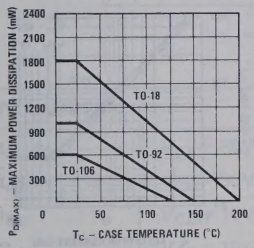
Base-Emitter On Voltage vs Collector Current



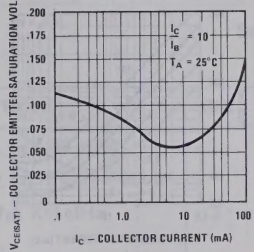
Maximum Power Dissipation vs Ambient Temperature



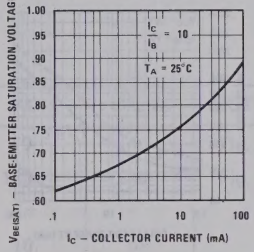
Maximum Power Dissipation vs Case Temperature



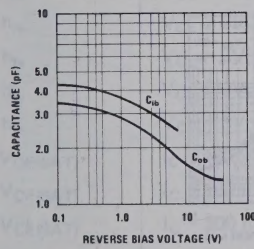
$V_{CE(SAT)}$ vs I_C



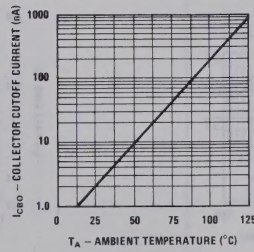
$V_{BE(SAT)}$ vs I_C



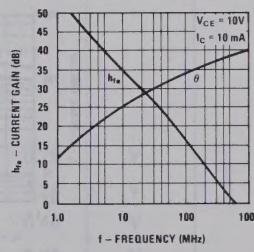
Capacitance vs Reverse Bias Voltage



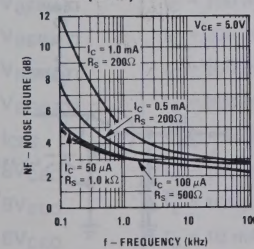
Collector Cutoff Current vs Ambient Temperature



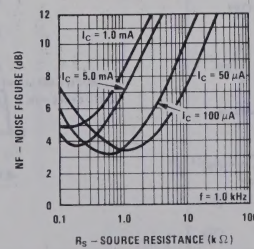
Current Gain and Phase Angle vs Frequency



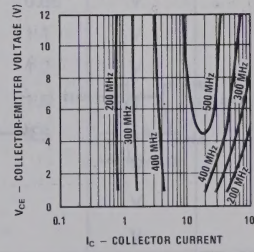
Noise Figure vs Frequency



Noise Figure vs Source Resistance



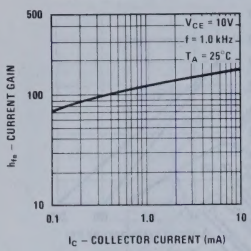
Contours of Constant Gain Bandwidth Product (f_T)



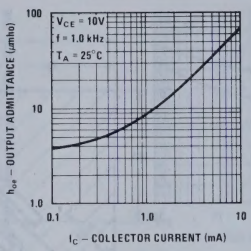
Process 23

h PARAMETERS (V_{CE} = 10 V_{DC}, f = 1.0 kHz, T_A = 25°C)

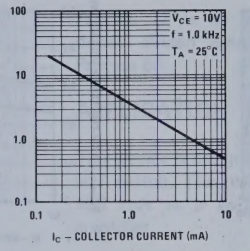
Current Gain



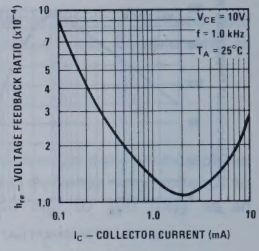
Output Admittance



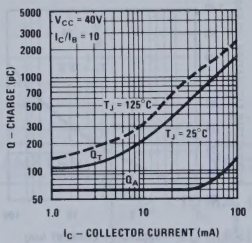
Input Impedance



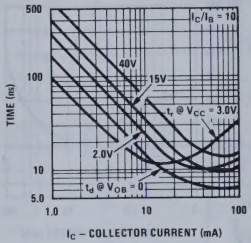
Voltage Feedback Ratio



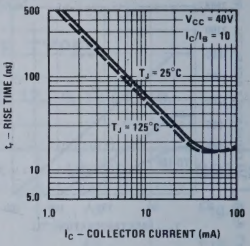
Charge Data



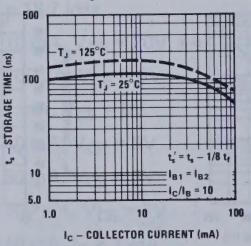
Turn On Time



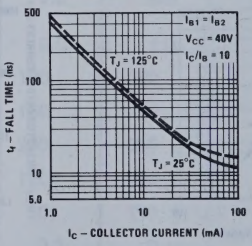
Rise Time



Storage Time



Fall Time



TRANSIENT CHARACTERISTICS (–T_J = 25°C --- T_J = 125°C)

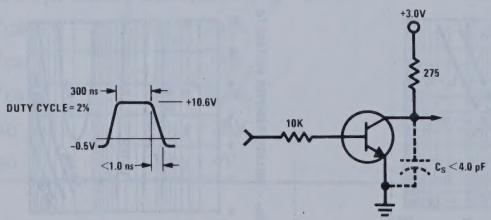


FIGURE 1. Delay and Rise Time Equivalent Test Circuit

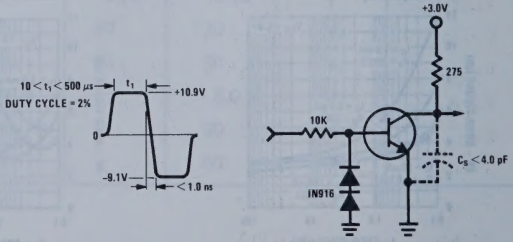
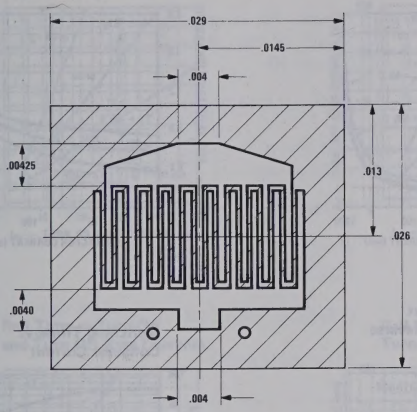


FIGURE 2. Storage and Fall Time Equivalent Test Circuit

Process 24 NPN High Speed High Voltage Switch



DESCRIPTION

Process 24 is an overlay double diffused gold doped epitaxial device.

APPLICATION

This device was designed for High Voltage, High Current core driver applications.

PRINCIPAL DEVICE TYPES:

TO-39 (pkg. 17) 2N3723

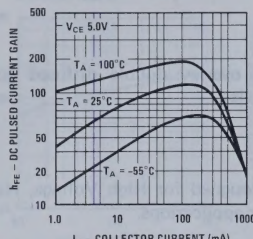
OTHER DEVICE TYPES

See page 2.

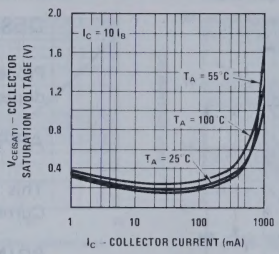
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
t_{on}	V_{CE} = 30V, I_C = 500 mA, I_B = 50 mA		25	70	ns	Fig. 1
t_{off}	V_{CE} = 30V, I_C = 500 mA, I_{B1} = $-I_{B2}$ = 50 mA		70	130	ns	Fig. 1
h_{fe}	V_{CE} = 10V, I_C = 50 mA, f = 100 MHz	3	4			
C_{ob}	V_{CB} = 10V		6	10	pF	
C_{ib}	V_{EB} = 0.5V		50	65	pF	
h_{fe}	V_{CE} = 1V, I_C = 10 mA	25	45			
h_{fe}	V_{CE} = 1V, I_C = 100 mA	40	70	150		
h_{fe}	V_{CE} = 2V, I_C = 300 mA	15	35			
h_{fe}	V_{CE} = 2V, I_C = 500 mA	15	30			
h_{fe}	V_{CE} = 3V, I_C = 500 mA	15	25			
h_{fe}	V_{CE} = 3V, I_C = 800 mA	12	30			
$V_{CE(SAT)}$	I_C = 10 mA, I_B = 1 mA		0.16	0.25	V	
$V_{CE(SAT)}$	I_C = 100 mA, I_B = 10 mA		0.22	0.28	V	
$V_{CE(SAT)}$	I_C = 300 mA, I_B = 30 mA		0.4	0.44	V	
$V_{CE(SAT)}$	I_C = 500 mA, I_B = 50 mA		0.3	0.75	V	
$V_{CE(SAT)}$	I_C = 800 mA, I_B = 80 mA		0.6	2.0	V	
$V_{BE(SAT)}$	I_C = 10 mA, I_B = 1 mA			0.75	V	
$V_{BE(SAT)}$	I_C = 100 mA, I_B = 10 mA			0.85	V	
$V_{BE(SAT)}$	I_C = 300 mA, I_B = 30 mA			1.1	V	
$V_{BE(SAT)}$	I_C = 500 mA, I_B = 50 mA	.86		1.2	V	
$V_{BE(SAT)}$	I_C = 800 mA, I_B = 80 mA			1.5	V	
I_{CES}	V_{CE} = 50V			0.5	μA	
BV_{CBO}	I_C = 100 μA	80			V	
BV_{EBO}	I_E = 100 μA	6			V	
BV_{CEO}	I_C = 10 mA	60	80		V	

Process 24

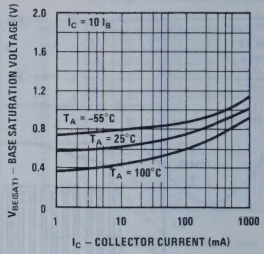
DC Pulsed Current Gain vs Collector Current



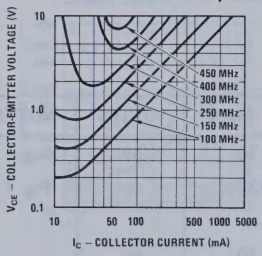
Collector Saturation Voltage vs Collector Current



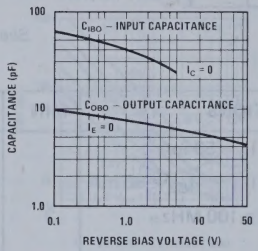
Base Saturation Voltage vs Collector Current



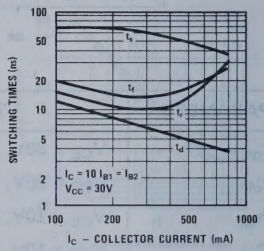
Contours of Constant Gain Bandwidth Product (f_T)



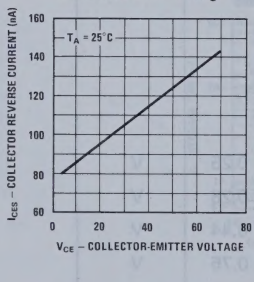
Input and Output Capacitance vs Reverse Bias Voltage



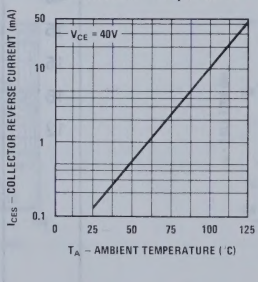
Switching Times vs Collector Current



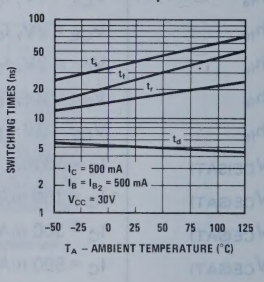
Collector Cutoff Current vs Reverse Bias Voltage



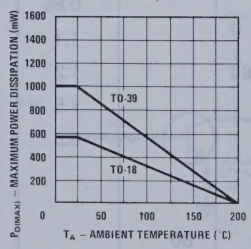
Collector Cutoff Current vs Ambient Temperature



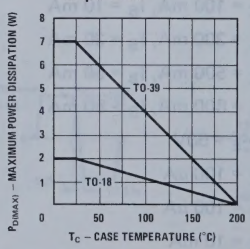
Switching Times vs Ambient Temperature



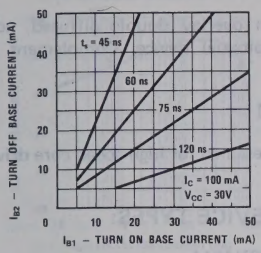
Maximum Power Dissipation vs Ambient Temperature



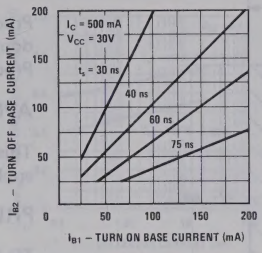
Maximum Power Dissipation vs Case Temperature



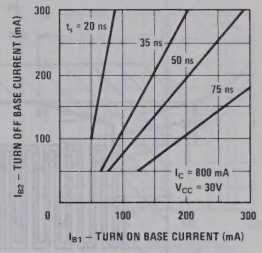
Storage Time vs Turn On and Turn Off Base Current



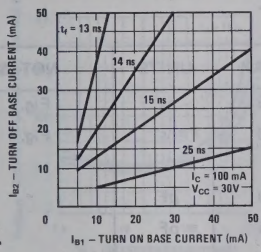
Storage Time vs Turn On and Turn Off Base Current



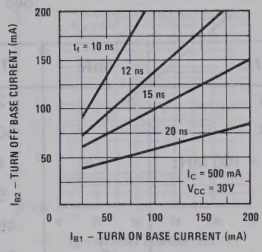
Storage Time vs Turn On and Turn Off Base Current



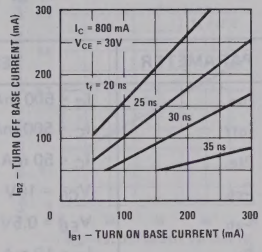
Fall Time vs Turn On and Turn Off Base Currents



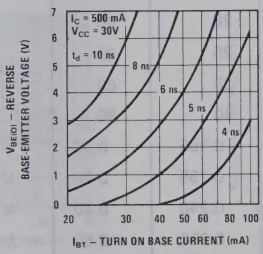
Fall Time vs Turn On and Turn Off Base Current



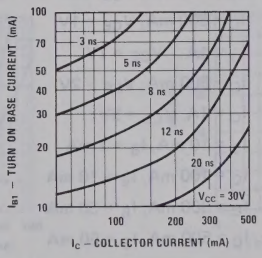
Fall Time vs Turn On and Turn Off Base Current



Delay Time vs Turn On Base Current and Reverse Base Emitter Voltage



Rise Time vs Collector and Turn On Base Current



SWITCHING TIME TEST CIRCUIT

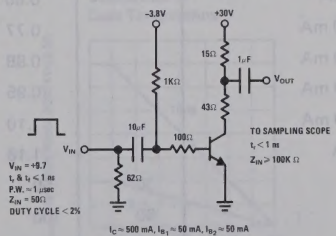
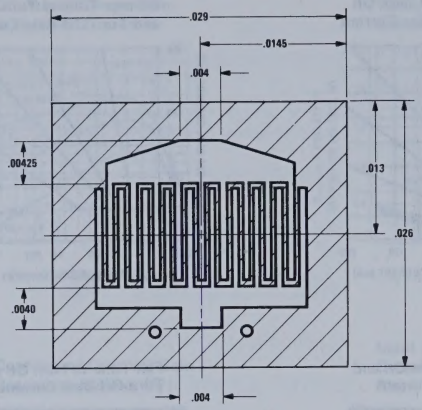


FIGURE 1.

Process 25 NPN Memory Driver



DESCRIPTION

Process 25 is an overlay double diffused, gold doped silicon epitaxial device. Complement to Process 70.

APPLICATION

This device was designed for high speed core driver applications.

PRINCIPAL DEVICE TYPES:

TO-18 2N4014
TO-39 (pkg. 17) 2N3725

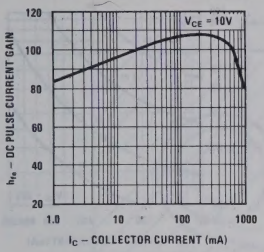
OTHER DEVICE TYPES

See pages 2 and 3.

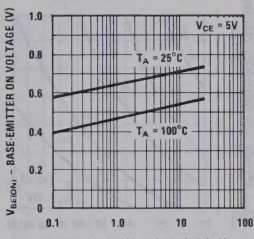
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
t_{on}	I_C = 500 mA, I_{B1} = 50 mA		12	35	ns	Fig. 1
t_{off}	I_C = 500 mA, I_{B2} = 50 mA		50	60	ns	Fig. 1
h_{fe}	I_C = 50 mA, V_{CE} = 10V, f = 100 MHz	2.5	4.25			
C_{cb}	V_{CB} = 10V		5	10	pF	
C_{eb}	V_{EB} = 0.5V		45	55	pF	
h_{fe}	I_C = 10 mA, V_{CE} = 1V	40	60	120		
h_{fe}	I_C = 100 mA, V_{CE} = 1V	60	90	150		
h_{fe}	I_C = 300 mA, V_{CE} = 1V	35	65	120		
h_{fe}	I_C = 500 mA, V_{CE} = 1V	25	50	100		
h_{fe}	I_C = 800 mA, V_{CE} = 1V	20	28	40		
h_{fe}	I_C = 1A, V_{CE} = 1V	15	25	35		
h_{fe}	I_C = 800 mA, V_{CE} = 2V	25	38	60		
h_{fe}	I_C = 1A, V_{CE} = 5V	25	40	60		
$V_{CE(SAT)}$	I_C = 10 mA, I_B = 1 mA		0.155	0.20	V	
$V_{CE(SAT)}$	I_C = 100 mA, I_B = 10 mA		0.155	0.20	V	
$V_{CE(SAT)}$	I_C = 300 mA, I_B = 30 mA		0.240	0.40	V	
$V_{CE(SAT)}$	I_C = 500 mA, I_B = 50 mA		0.350	0.50	V	
$V_{CE(SAT)}$	I_C = 800 mA, 80 mA		0.50	0.80	V	
$V_{CE(SAT)}$	I_C = 1A, I_B = 100 mA		0.70	1.20	V	
$V_{BE(SAT)}$	I_C = 10 mA, I_B = 1 mA		0.66	0.70	V	
$V_{BE(SAT)}$	I_C = 100 mA, I_B = 10 mA		0.77	0.85	V	
$V_{BE(SAT)}$	I_C = 300 mA, I_B = 30 mA		0.88	1.20	V	
$V_{BE(SAT)}$	I_C = 500 mA, I_B = 50 mA		0.95	1.20		
$V_{BE(SAT)}$	I_C = 800 mA, I_B = 80 mA		1.10	1.50	V	
$V_{BE(SAT)}$	I_C = 1A, I_B = 100 mA		1.18	1.70	V	
BV_{CEO}	I_C = 10 mA	30	50	60	V	
BV_{CBO}	I_C = 100 μA	50	100	140	V	
BV_{EBO}	I_C = 10 μA	5.5	6.5	7.0	V	
I_{CBO}	V_{CB} = 40V			1.0	μA	
I_{EBO}	V_{EB} = 4V			1.0	μA	

Process 25

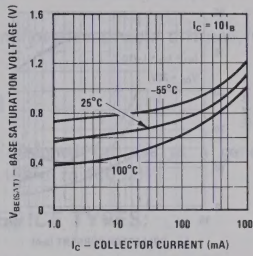
DC Pulse Current Gain vs Collector Current



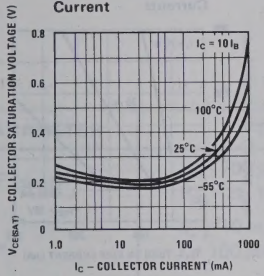
Base-Emitter On Voltage vs Collector Current



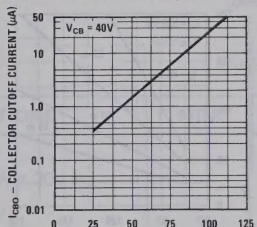
Base Saturation Voltage vs Collector Current



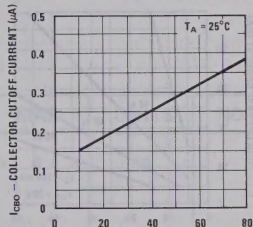
Collector Saturation Voltage vs Collector Current



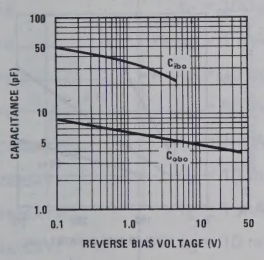
Collector Cutoff Current vs Ambient Temperature



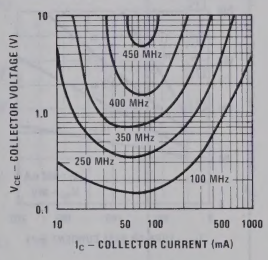
Collector Cutoff Current vs Reverse Bias Voltage



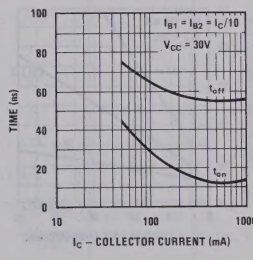
Input and Output Capacitance vs Reverse Bias



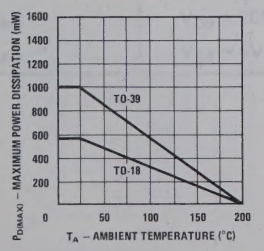
Contours of Constant Bandwidth Product (f_T)



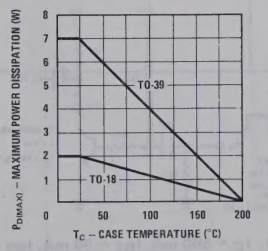
Turn On and Turn Off Times vs Collector Current



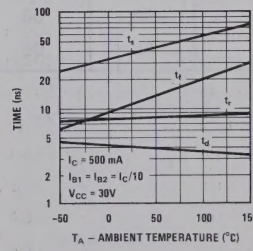
Maximum Power Dissipation vs Ambient Temperature



Maximum Power Dissipation vs Case Temperature

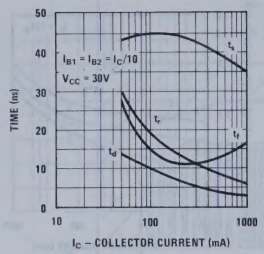


Switching Times vs Ambient Temperature

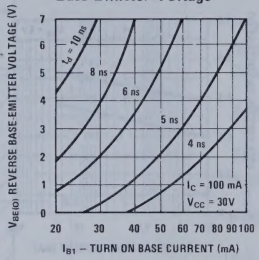


Process 25

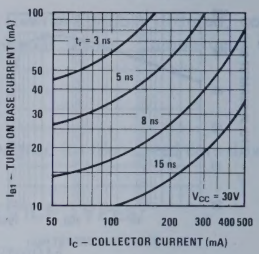
Switching Times vs Collector Current



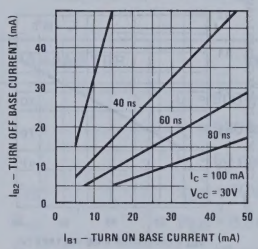
Delay Time vs Turn On Base Current and Reverse Base Emitter Voltage



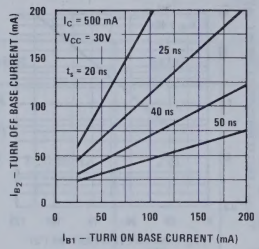
Rise Time vs Collector and Turn On Base Currents



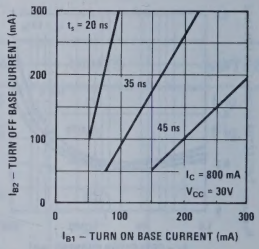
Storage Time vs Turn On and Turn Off Base Currents



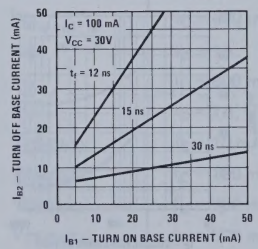
Storage Time vs Turn On and Turn Off Base Currents



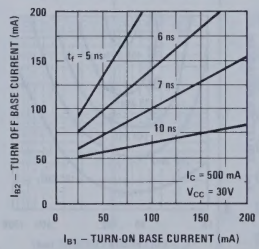
Storage Time vs Turn On and Turn Off Base Currents



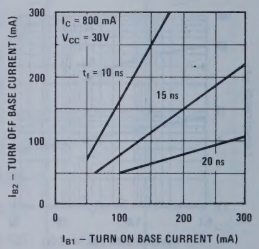
Fall Time vs Turn On and Turn Off Base Currents



Fall Time vs Turn On and Turn Off Base Currents



Fall Time vs Turn On and Turn Off Base Currents



SWITCHING TIME TEST CIRCUIT

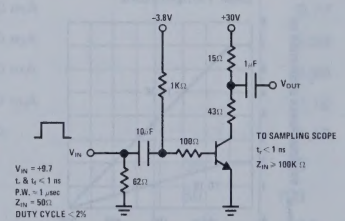
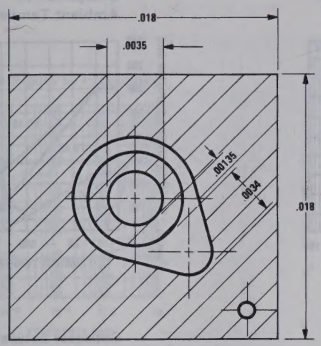


FIGURE 1. $I_C \approx 500$ mA, $I_{B1} \approx 50$ mA, $I_{B2} \approx -50$ mA

Process 26 NPN Small Signal



DESCRIPTION

Process 26 is a nonoverlay double diffused, silicon device.

APPLICATION

This device was designed for use as a general purpose amplifier useful to 100 MHz.

PRINCIPLE DEVICE TYPES:

TO-106 SE1001

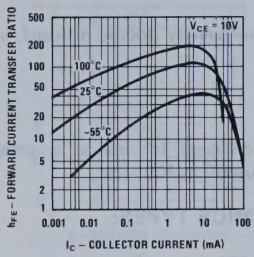
OTHER DEVICE TYPES

See page 8.

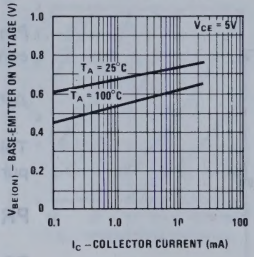
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
NF (spot)	I_C = 200 μA, V_{CE} = 5V R_S = 2k, f = 1 kHz, PBW = 200 Hz		1.5	4	dB	
h_{fe}	I_C = 10 mA, V_{CE} = 10V f = 100 MHz	2	4			
C_{cb}	V_{CB} = 10V		2.0	3.5	pF	TO-92
C_{eb}	V_{EB} = .5V		7.0	10	pF	
h_{FE}	I_C = 10 μA, V_{CE} = 10V	20	50			
h_{FE}	I_C = 100 μA, V_{CE} = 10V	20	80			
h_{FE}	I_C = 1 mA, V_{CE} = 10V	20	100			
h_{FE}	I_C = 10 mA, V_{CE} = 10V	20	120	400		
h_{FE}	I_C = 50 mA, V_{CE} = 10V	10	130			
$V_{CE(SAT)}$	I_C = 1 mA, I_B = .1 mA		0.2	1	V	
$V_{CE(SAT)}$	I_C = 10 mA, I_B = 1 mA		0.45	2	V	
$V_{BE(SAT)}$	I_C = 1 mA, I_B = .1 mA		0.65	0.80	V	
$V_{BE(SAT)}$	I_C = 10 mA, I_B = 1 mA		0.8	1.0	V	
BV_{CEO}	I_C = 10 mA	40			V	
BV_{CBO}	I_C = 100 μA	40			V	
BV_{EBO}	I_E = 10 μA	5			V	
I_{CBO}	V_{CB} = 20V			50	nA	
I_{EBO}	V_{EB} = 3V			50	nA	

Process 26

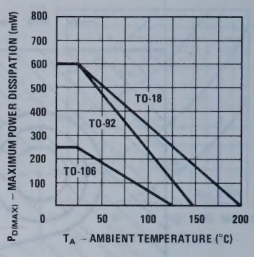
Pulsed DC Current Gain vs Collector Current



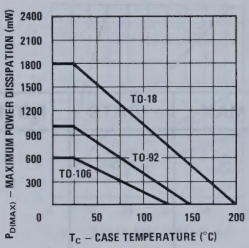
Base-Emitter On Voltage vs Collector Current



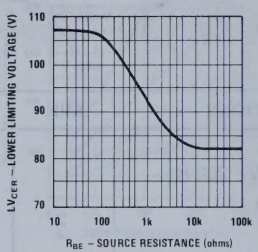
Maximum Power Dissipation vs Ambient Temperature



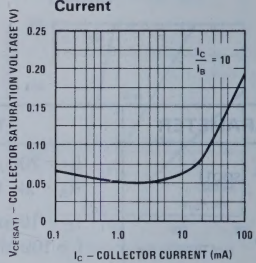
Maximum Power Dissipation vs Case Temperature



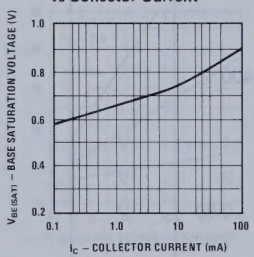
Lower Limiting Voltage vs Source Resistance



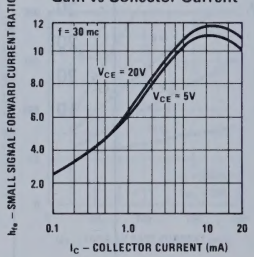
Collector Saturation Voltage vs Collector Current



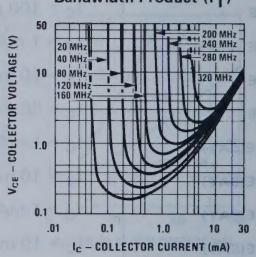
Base Saturation Voltage vs Collector Current



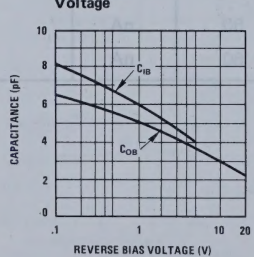
High Frequency Current Gain vs Collector Current



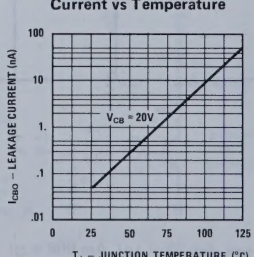
Contours of Constant Gain Bandwidth Product (f_T)



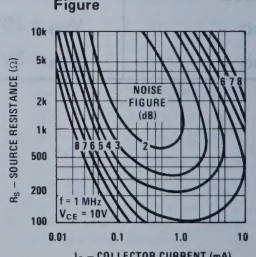
Capacitance vs Reverse Bias Voltage



Collector-Base Diode Reverse Current vs Temperature

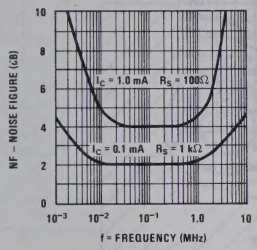


Contours of Spot Noise Figure

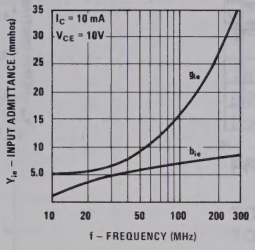


Process 26

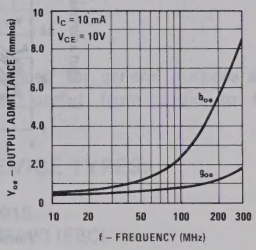
Noise Figure vs Frequency



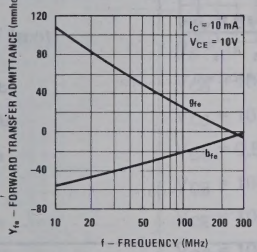
Input Admittance vs Frequency-Output Short Circuit



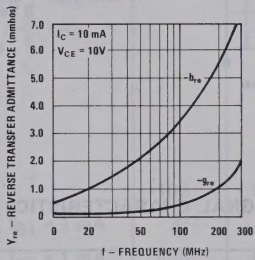
Output Admittance vs Frequency-Input Short Circuit



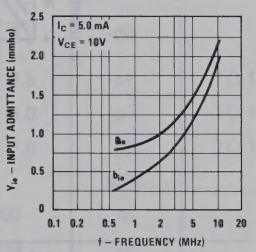
Forward Transfer Admittance vs Frequency-Output Short Circuit



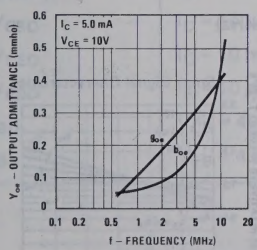
Reverse Transfer Admittance vs Frequency-Input Short Circuit



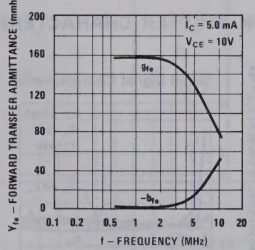
Input Admittance vs Frequency-Output Short Circuit



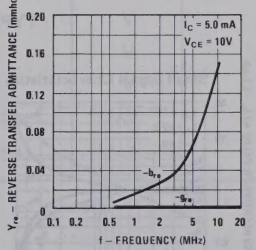
Output Admittance vs Frequency-Input Short Circuit



Forward Transfer Admittance vs Frequency-Output Short Circuit

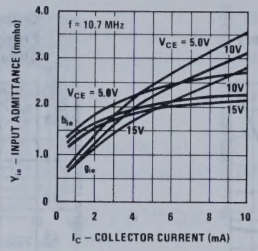


Reverse Transfer Admittance vs Frequency-Input Short Circuit

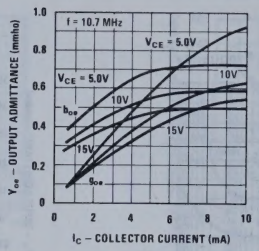


Process 26

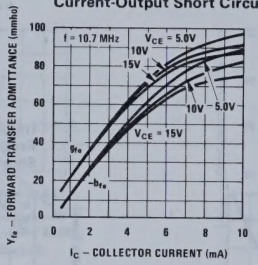
Input Admittance vs Collector Current-Output Short Circuit



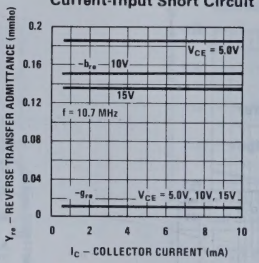
Output Admittance vs Collector Current-Input Short Circuit



Forward Transfer Admittance vs Collector Current-Output Short Circuit



Reverse Transfer Admittance vs Collector Current-Input Short Circuit

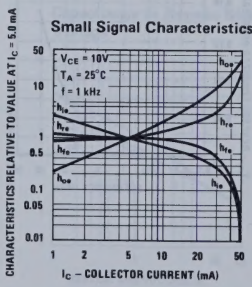


SMALL SIGNAL CHARACTERISTICS (f = 1.0 kHz)

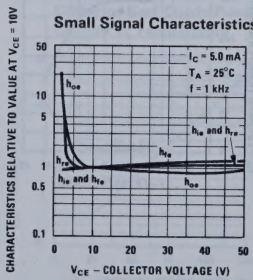
SYMBOL	CHARACTERISTIC	TYP.	UNITS	TEST CONDITIONS
h_{ie}	Input Resistance	1130	Ohms	I_C = 5.0 mA V_{CE} = 10V
h_{oe}	Output Conductance	35	μmho	I_C = 5.0 mA V_{CE} = 10V
h_{re}	Voltage Feedback Ratio	1.25	x10^{-4}	I_C = 5.0 mA V_{CE} = 10V
h_{fe}	Small Signal Current Gain	145		I_C = 5.0 mA V_{CE} = 10V

TYPICAL COMMON EMITTER CHARACTERISTICS (f = 1.0 kHz)

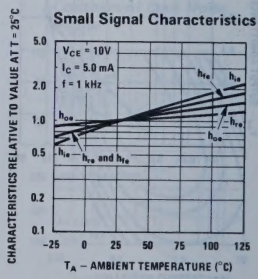
Small Signal Characteristics



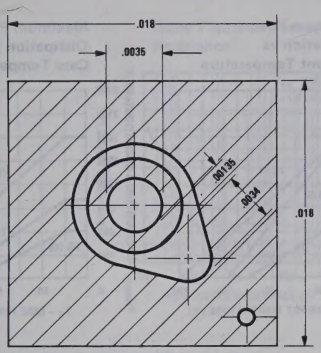
Small Signal Characteristics



Small Signal Characteristics



Process 27 NPN Small Signal



DESCRIPTION

Process 27 is a nonoverlay, double diffused, silicon epitaxial device. Complement to Process 69.

APPLICATION

This device is designed for general purpose amplifier and switch useful from audio to RF frequencies.

PRINCIPAL DEVICE TYPES:

TO-18	2N915
TO-92	MPSA20 (EBC)
TO-106	2N3694

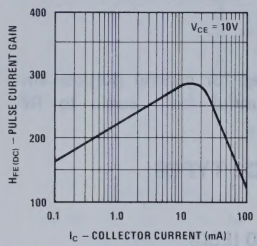
OTHER DEVICE TYPES

See pages 5, 7, 10, 14, 16 through 19.

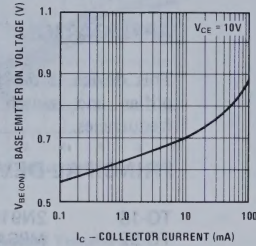
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
NF (wide band)	V_{CE} = 5, I_C = 100 μA, f_{BW} = 15.7 kHz		1.5		dB	
NF (spot)	V_{CE} = 5V, I_C = 100 μA, f = 1 kHz R_S = 1k		1.5	3.0	dB	
C_{cb}	V_{CB} = 10V, f = 1 MHz		2.0	2.5	pF	TO-18
C_{ob}	V_{CB} = 10V, f = 1 MHz		2.5	3.0	pF	TO-18
C_{ib}	V_{EB} = 0.50V, f = 1 MHz		5.5	7.0	pF	TO-18
f_T	V_{CE} = 10V, I_C = 10 mA	100	500		MHz	
t_{on}	V_{CE} = 10V, I_C = 10 mA, I_{B1} = 1 mA	30	40	50	ns	
t_{off}	V_{CE} = 10V, I_C = 10 mA, I_{B2} = 1 mA	400	600	700	ns	
h_{FE}	V_{CE} = 10V, I_C = 100 μA	50	200	500		
h_{FE}	V_{CE} = 10V, I_C = 1 mA	50	220	500		
h_{FE}	V_{CE} = 10V, I_C = 10 mA	50	250	500		
h_{FE}	V_{CE} = 10V, I_C = 50 mA	50	240	500		
$V_{CE(SAT)}$	I_C = 10 mA, I_B = 1 mA		0.055	0.10	V	
$V_{BE(SAT)}$	I_C = 10 mA, I_B = 1 mA		0.770	1.0	V	
BV_{CBO}	I_C = 100 μA	50	70		V	
BV_{CEO}	I_C = 10 mA	30	50		V	
BV_{EBO}	I_E = 10 μA	5.0	6.5		V	
I_{CBO}	V_{CB} = 40			50	nA	
I_{EBO}	V_{EB} = 4.0			50	nA	

Process 27

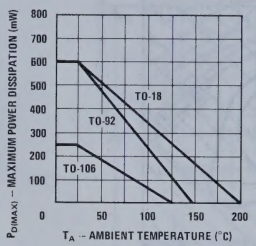
DC Pulse Current Gain vs Collector Current



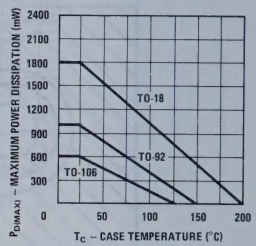
Base-Emitter On Voltage vs Collector Current



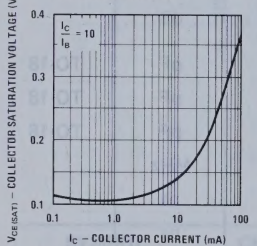
Maximum Power Dissipation vs Ambient Temperature



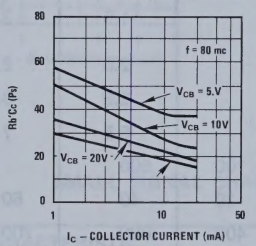
Maximum Power Dissipation vs Case Temperature



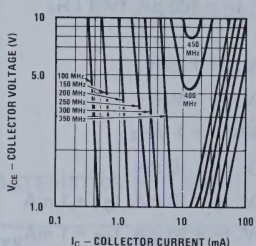
Collector-Emitter Saturation Voltage vs Collector Current



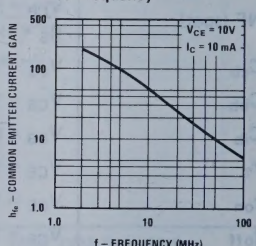
Rb'Cc vs Collector Current



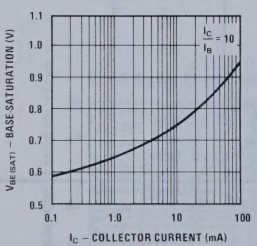
Small Signal Current Gain vs Collector Current



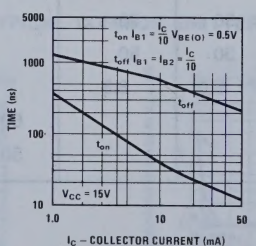
Small Signal Current Gain vs Frequency



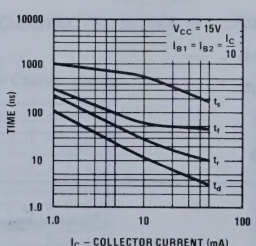
Base Saturation Voltage vs Collector Current



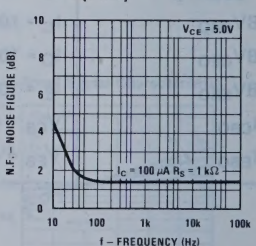
t_{on} And t_{off} vs Collector Current



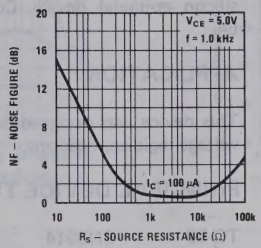
Switching Times vs Collector Current



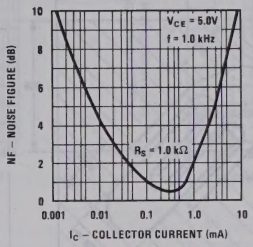
Noise Figure vs Frequency



Noise Figure vs Source Resistance

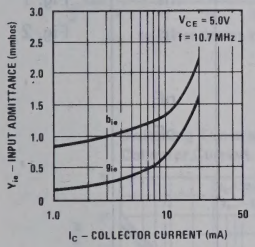


Noise Figure vs Collector Current

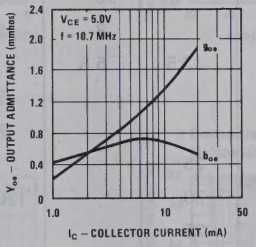


COMMON EMITTER Y PARAMETERS

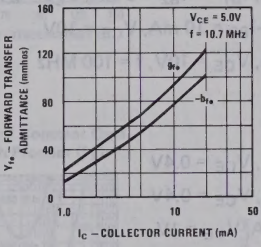
Input Admittance vs Collector Current



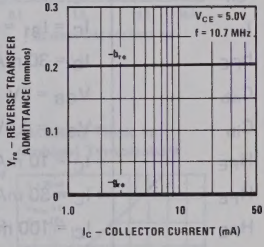
Output Admittance vs Collector Current



Forward Transfer Admittance vs Collector Current

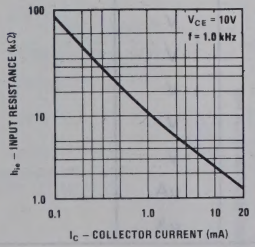


Reverse Transfer Admittance vs Collector Current

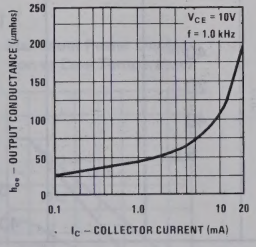


COMMON EMITTER H PARAMETERS

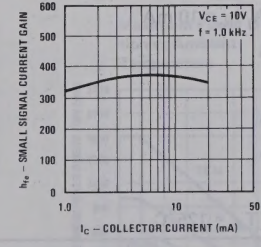
Small Signal Input Resistance vs Collector Current



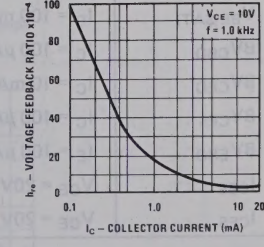
Small Signal Output Conductance vs Collector Current



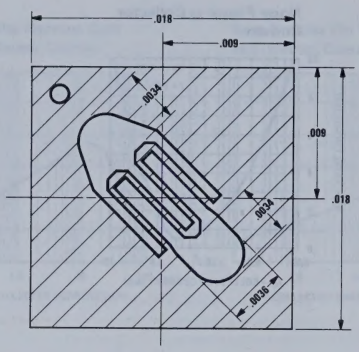
Small Signal Current Gain vs Collector Current



Small Signal Voltage Feedback Ratio vs Collector Current



Process 28 NPN High Speed Switch



DESCRIPTION

Process 28 is a double diffused, gold doped, silicon epitaxial device. Complement to Process 64.

APPLICATION

This device was designed for high speed medium voltage logic applications.

PRINCIPAL DEVICE TYPES:

TO-52 2N3014

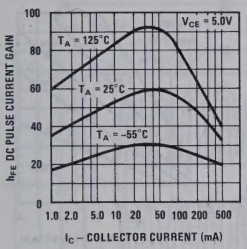
OTHER DEVICE TYPES

See page 1.

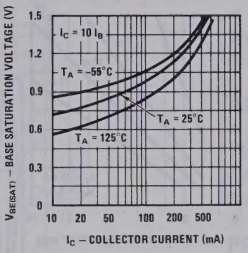
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
t_{on}	I_C = 30 mA, I_{B1} = 3 mA, V_{CE} 2V		11	16	ns	Fig. 1
t_{off}	I_C = 30 mA, I_{B1} = $-I_{B2}$ = 3 mA, V_{CE} = 2V		16	25	ns	Fig. 1
t_s	I_C = I_{B1} = $-I_{B2}$ = 10 mA, V_{CE} = 10V		8	18	ns	Fig. 2
h_{FE}	I_C = 30 mA, V_{CE} = 10V, f = 100 MHz	3.5	5.5			
C_{ob}	V_{CB} = 5V			5	pF	
C_{ib}	V_{EB} = 0.5V			8	pF	
H_{FE}	I_C = 10 mA, V_{CE} = 0.4V	25				
H_{FE}	I_C = 30 mA, V_{CE} = 0.4V	30		120		
H_{FE}	I_C = 100 mA, V_{CE} = 1V	25				
H_{FE}	I_C = 30 mA, V_{CE} = 0.4V, T_A = –55°C	12				
$V_{CE(SAT)}$	I_C = 10 mA, I_B = 1 mA			0.18	V	
$V_{CE(SAT)}$	I_C = 30 mA, I_B = 3 mA			0.18	V	
$V_{CE(SAT)}$	I_C = 100 mA, I_B = 10 mA			0.35	V	
$V_{BE(SAT)}$	I_C = 10 mA, I_B = 1 mA			0.8	V	
$V_{BE(SAT)}$	I_C = 30 mA, I_B = 3 mA			0.95	V	
$V_{BE(SAT)}$	I_C = 100 mA, I_B = 10 mA			1.2	V	
BV_{CBO}	I_C = 100 μA	40			V	
BV_{CEO}	I_C = 10 mA	20			V	
BV_{CES}	I_C = 100 μA	40			V	
BV_{EBO}	I_E = 100 μA	5.0			V	
I_{CES}	V_{CE} = 20V			0.3	μA	
I_{CES}	V_{CE} = 20V, T_A = 125°C			40	μA	

Process 28

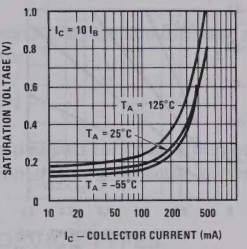
DC Pulse Current Gain vs Collector Current



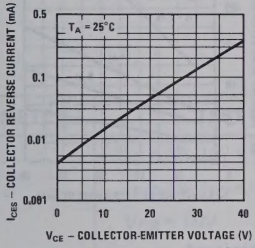
Base Saturation Voltage vs Collector Current



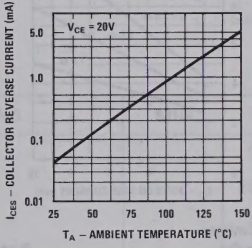
Collector Saturation Voltage vs Collector Current



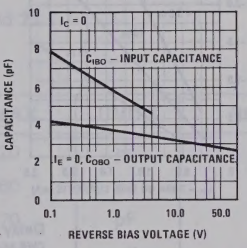
Collector Reverse Current vs Reverse Bias Voltage



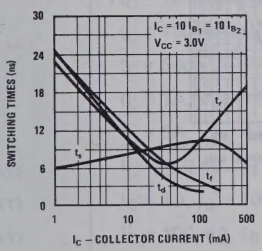
Collector Reverse Current vs Ambient Temperature



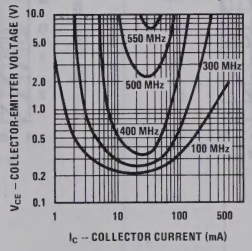
Input and Output Capacitance vs Reverse Bias Voltage



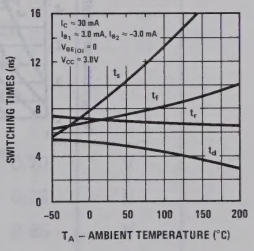
Switching Times vs Collector Current



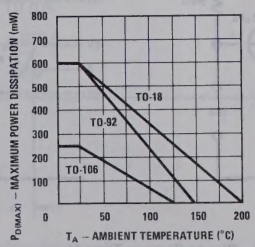
Contours of Constant Gain Bandwidth Product (f_T)



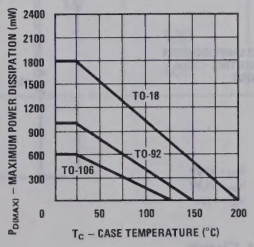
Switching Times vs Ambient Temperature



Maximum Power Dissipation vs Case Temperature

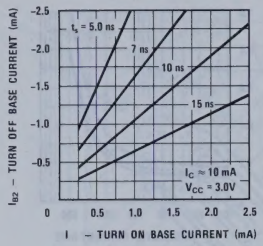


Maximum Power Dissipation vs Ambient Temperature

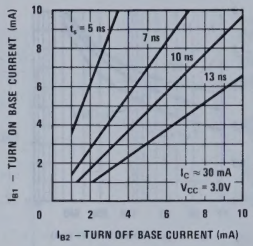


Process 28

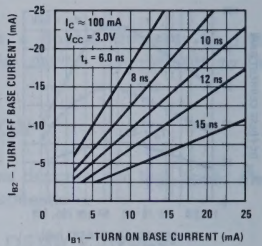
Storage Time vs Turn On and Turn Off Base Currents



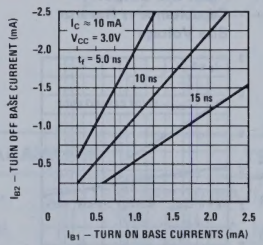
Storage Time vs Turn On and Turn Off Base Currents



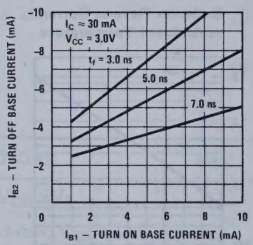
Storage Time vs Turn On and Turn Off Base Currents



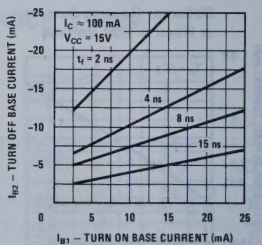
Fall Time vs Turn On and Turn Off Base Currents



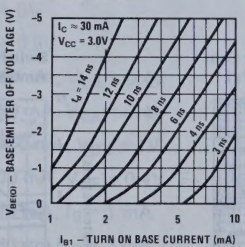
Fall Time vs Turn On and Turn Off Base Currents



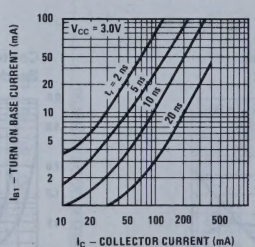
Fall Time vs Turn On and Turn Off Base Currents



Delay Time vs Base-Emitter Off Voltage and Turn On Base Current



Rise Time vs Collector and Turn On Base Current



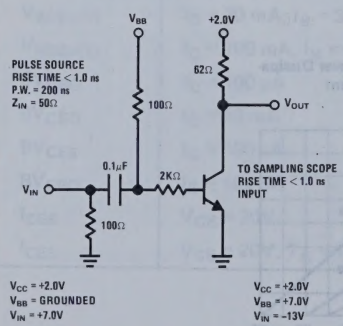


FIGURE 1. t_{on} and t_{off} Test Circuit

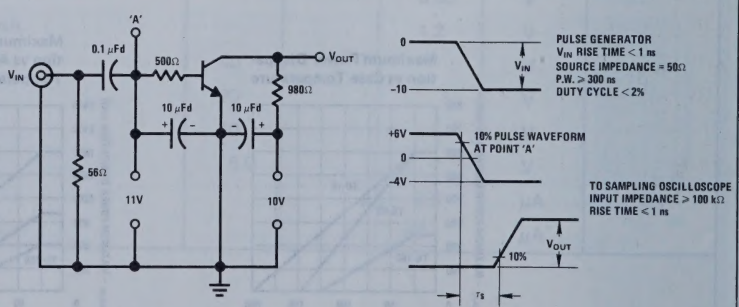
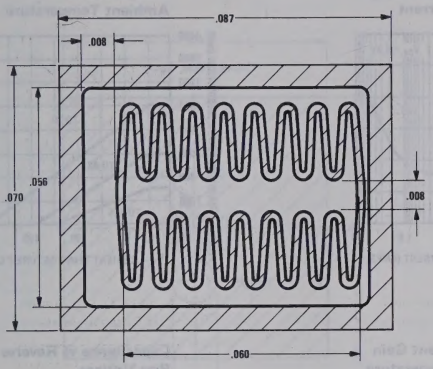


FIGURE 2. Charge Storage Time Measurement Circuit

Process 34 NPN Power Signal



DESCRIPTION

This device is nonoverlay double diffused, silicon epitaxial transistor.

APPLICATION

This device was designed for general purpose amplifier application utilizing collector currents to 5 amps.

PRINCIPAL DEVICE TYPES:

TO-39 2N2891

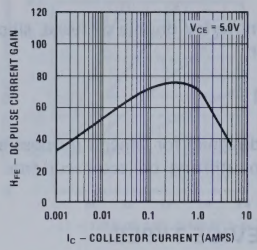
OTHER DEVICE TYPES

See pages 21 and 23.

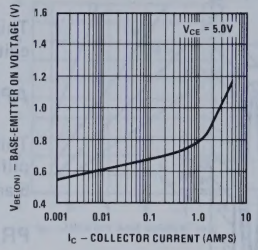
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
t_{on}	I_C = 1A, I_{B1} = 0.1A		90	120	ns	
t_{off}	I_C = 1A, I_{B2} = 0.1A		200	260	ns	
C_{ob}	V_{CB} = 10V		60	70	pF	
C_{ib}	V_{EB} = 0.5V		425	500	pF	
h_{fe}	I_C = 200 mA, V_{CE} = 10V, f = 20 MHz	4.0	5.0			
h_{FE}	I_C = 1 mA, V_{CE} = 5V	40	50	100		
h_{FE}	I_C = 10 mA, V_{CE} = 5V	40	70	100		
h_{FE}	I_C = 100 mA, V_{CE} = 5V	40	90	120		
h_{FE}	I_C = 500 mA, V_{CE} = 5V	40	95	150		
h_{FE}	I_C = 1A, V_{CE} = 5V	20	30	100		
h_{FE}	I_C = 5A, V_{CE} = 5V	15	20			
$V_{CE(SAT)}$	I_C = 100 mA, I_B = 10 mA		0.05	0.10	V	
$V_{CE(SAT)}$	I_C = 1A, I_B = 100 mA		0.20	0.25	V	
$V_{BE(SAT)}$	I_C = 100 mA, I_B = 10 mA		0.70	0.85	V	
$V_{BE(SAT)}$	I_C = 1A, I_B = 100 mA		0.90	1.10	V	
BV_{CEO}	I_C = 10 mA	80	100			
BV_{CBO}	I_C = 100 μA	100	150			
BV_{EBO}	I_E = 10 μA	8	10			
I_{CBO}	V_{CB} = 60V			100	nA	
I_{EBO}	V_{EB} = 6V			100	nA	

Process 34

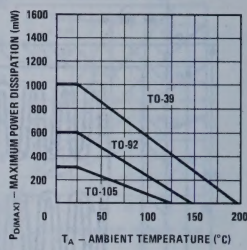
Pulsed DC Current Gain vs Collector Current



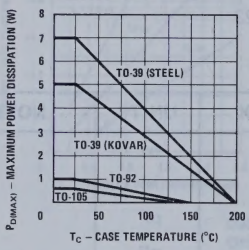
Base-Emitter On Voltage vs Collector Current



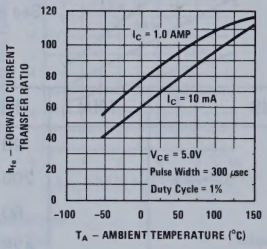
Maximum Power Dissipation vs Ambient Temperature



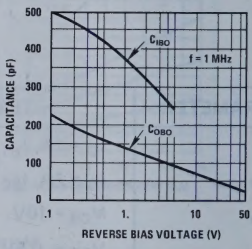
Maximum Power Dissipation vs Case Temperature



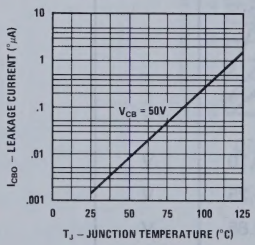
Pulsed DC Current Gain vs Ambient Temperature



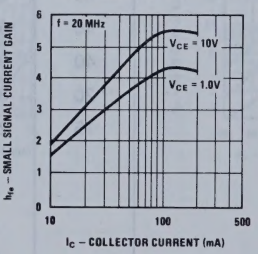
Capacitance vs Reverse Bias Votlage



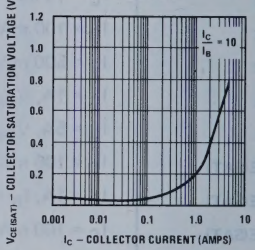
Collector-Base Diode Reverse Current vs Temperature



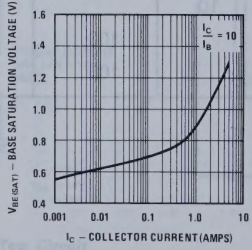
Small Signal Current Gain vs Collector Current



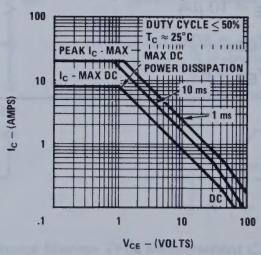
Collector-Emitter Saturation Voltage vs Collector Current



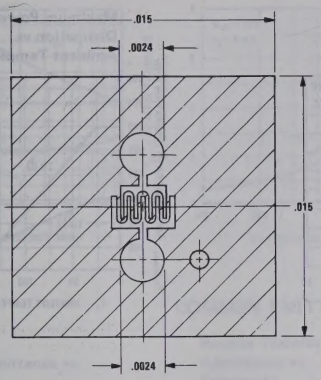
Base-Emitter Saturation Voltage vs Collector Current



Safe Region of Operation



Process 42 NPN RF Amplifier



DESCRIPTION

Process 42 is an overlay double diffused silicon epitaxial device.

APPLICATION

This device was designed for use in low noise UHF/VHF amplifiers with collector current in the 100 μA to 10 mA range in common emitter or common base mode of operation.

PRINCIPAL DEVICE TYPES:

TO-72	2N5179
TO-92	2SC535 (ECB), MPS-H10 (BEC)

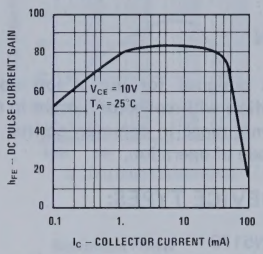
OTHER DEVICE TYPES

See pages 5 through 7.

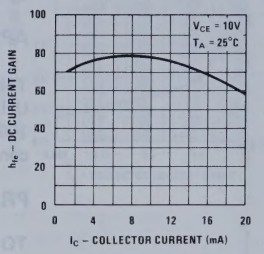
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
PG	$f = 450$ MHz, $V_{CE} = 10V$, $I_C = 2$ mA	10	14		dB	Fig. 1
NF	$f = 450$ MHz, $V_{CE} = 10V$, $I_C = 2$ mA $R_g = 50\Omega$			5.0	dB	Fig. 1
PG	$f = 200$ MHz, $V_{CE} = 10V$, $I_C = 2$ mA	22	27		dB	Fig. 2
NF	$f = 200$ MHz, $V_{CE} = 10V$, $I_C = 2$ mA $R_S = 120\Omega$		2.0	3.5	dB	Fig. 2
h_{fe}	$f = 100$ MHz, $V_{CE} = 10V$, $I_C = 5$ mA	7.0	10	15		
$r_b'C_c$	$f = 79.8$ MHz, $V_{CE} = 10V$, $I_C = 5$ mA		3.5	10	ps	TO-72
C_{cb}	$f = 1.0$ MHz, $V_{CB} = 10V$, $I_E = 0$		0.4	0.5	pF	TO-72
C_{ce}	$f = 1.0$ MHz, $V_{CE} = 10V$, $I_B = 0$		0.2	0.3	pF	TO-72
C_{eb}	$f = 1.0$ MHz, $V_{EB} = 0.5V$, $I_C = 0$		0.8	1.5	pF	TO-72
h_{FE}	$V_{CE} = 10V$, $I_C = 5$ mA	30	80	250		
h_{FE}	$V_{CE} = 6V$, $I_C = 1$ mA	20	65			
$V_{CE(SAT)}$	$I_C = 10$ mA, $I_B = 5$ mA		0.07	0.3	V	
BV_{CEO}	$I_C = 1$ mA	30	45		V	
BV_{CBO}	$I_C = 100\ \mu$A	35	50		V	
BV_{EBO}	$I_E = 10\ \mu$A	3.0	5.5		V	
I_{CBO}	$V_{CB} = 30V$			100	nA	
I_{EBO}	$V_{EB} = 2.0$			50	nA	

Process 42

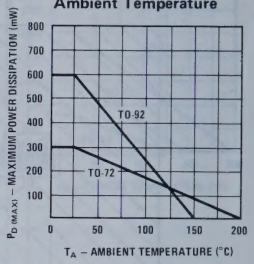
DC Pulse Current Gain vs Collector Current



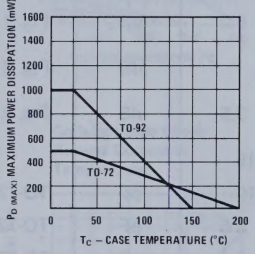
DC Current Gain vs Collector Current



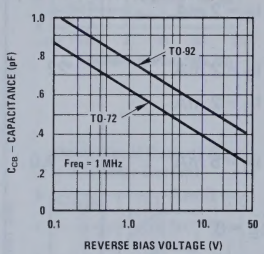
Maximum Power Dissipation vs Ambient Temperature



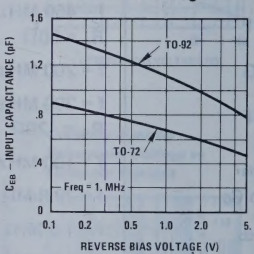
Maximum Power Dissipation vs Case Temperature



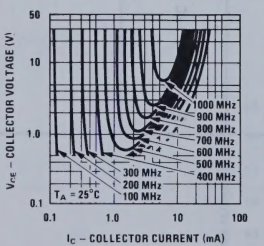
Reverse Transfer Capacitance vs Reverse Bias Voltage



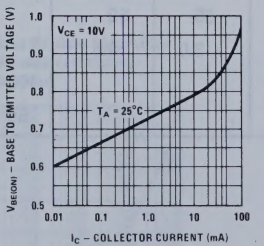
Input Capacitance vs Reverse Bias Voltage



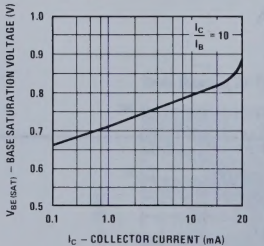
Contours Of Constant Gain Bandwidth Product (f_T)



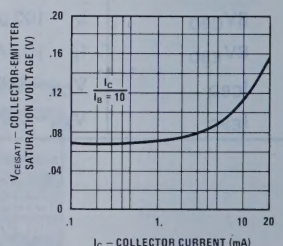
Base Emitter On Voltage vs Collector Current



Base-Emitter Saturation Voltage vs Collector Current

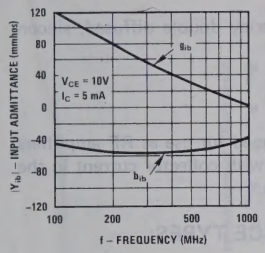


Collector-Emitter Saturation Voltage vs Collector Current

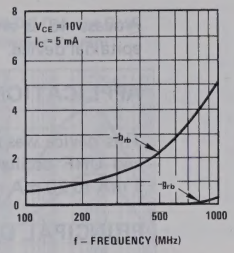


COMMON BASE Y PARAMETERS VS FREQUENCY

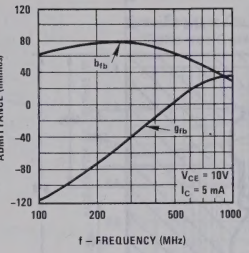
Input Admittance vs Frequency



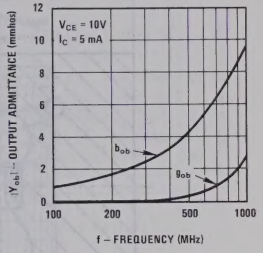
Reverse Transfer Admittance vs Frequency



Forward Transfer Admittance vs Frequency

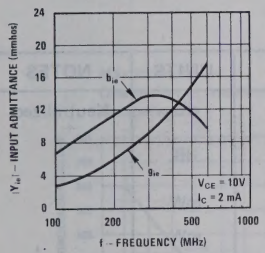


Output Admittance vs Frequency

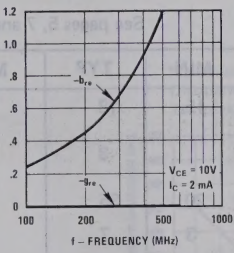


COMMON EMITTER Y PARAMETERS VS FREQUENCY

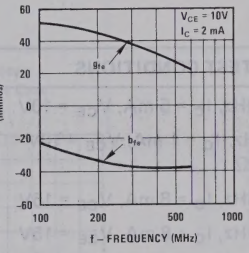
Input Admittance vs Frequency



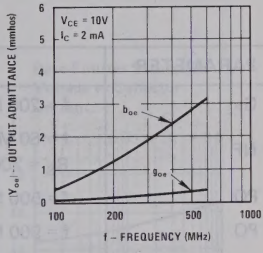
Reverse Transfer Admittance vs Frequency

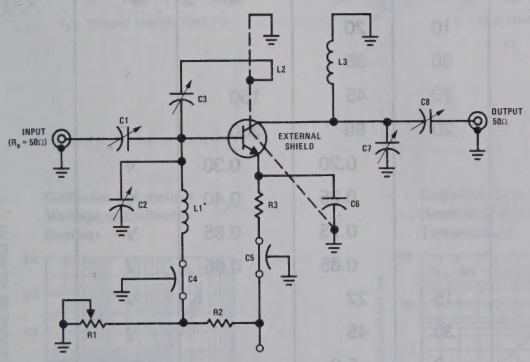


Forward Transfer Admittance vs Frequency



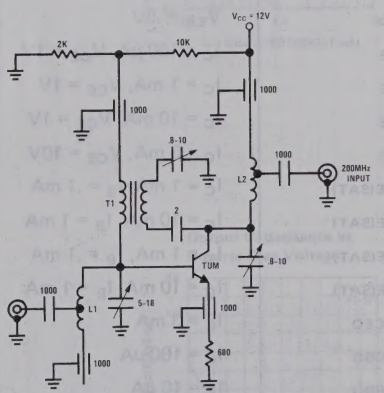
Output Admittance vs Frequency





C1, C2, C3, C7, C8 – 0.8-10 pF VARIABLE CAPACITOR
C3 – PLASTIC TUBULAR TRIMMER CAPACITOR [ADJUSTED AND FIXED FOR A TRANSISTOR HAVING A TYPICAL VALUE OF C_{ob} (0.35 pF)]
C4 – 200 pF BUTTON-TYPE FEEDTHROUGH CAPACITOR
C5 – 1000 pF FEEDTHROUGH CAPACITOR
C6 – 470 pF LEADLESS CERAMIC DISC CAPACITOR
L1, L3 – 1" LENGTH OF 1/4" DIAMETER COPPER BAR STOCK
L2 – 1/2 LOOP No. 14 AWG ENAMELED WIRE PARALLEL TO AND APPROXIMATELY 1/4" FROM L3
R1 – 5 kΩ POTENTIOMETER
R2 – 1.2 kΩ
R3 – 2 kΩ

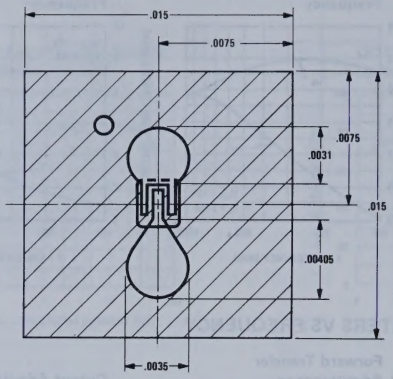
FIGURE 1. Neutralized 450-MHz Gain and Noise Figure Circuit



L1 – 3T =16 WIRE, 1/2"L x 1/4"ID TAPPED 1-1/2T FROM COLD SIDE
L2 – 6T =14 WIRE, 1"L x 1/4"ID TAPPED 1-1/2T FROM COLD SIDE
T1 – PRI. 1T -16 WIRE
SEC. 1T -18 WIRE
CORE IS INDIANA GENERAL P/N F-684-03
ALL CAPACITANCE IN pF, ALL RESISTANCE IN OHMS.

FIGURE 2. Neutralized 200-MHz PF & NF Circuit

Process 43 NPN UHF Oscillator



DESCRIPTION

Process 43 is an overlay double diffused, silicon epitaxial device.

APPLICATION

This device was designed for use as RF amplifiers and UHF oscillators with collector current in the 1 mA to 20 mA range.

PRINCIPAL DEVICE TYPES:

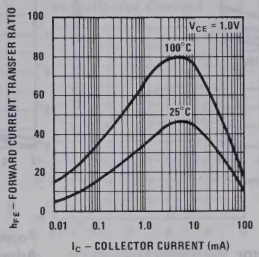
TO-72	2N918
TO-92	MPS3563 (EBC), 2N3663 (ECB)
TO-106	2N3563, SE3002

OTHER DEVICE TYPES

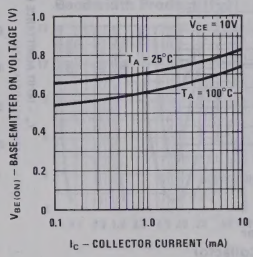
See pages 5, 7 and 8

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
G_{PE}	f = 200 MHz, I_C = 5 mA, V_{CE} = 10V	15	18		dB	Neutralized
NF	f = 60 MHz, I_C = 1 mA, V_{CE} = 10V R_S = 200Ω		3	5	dB	
PO	f = 500 MHz, I_C = 8 mA, V_{CE} = 15V	20	35		mW	
PO	f = 900 MHz, I_C = 8 mA, V_{CE} = 15V	3	7		mW	
h_{fe}	I_C = 5 mA, V_{CE} = 10V, f = 100 MHz	6	9			
C_{ob}	V_{CB} = 10V		1.5	2.5	pF	
C_{eb}	V_{EB} = .5V		1.4	2.0	pF	
h_{FE}	I_C = 100 μA, V_{CE} = 1V	10	20			
h_{FE}	I_C = 1 mA, V_{CE} = 1V	20	35			
h_{FE}	I_C = 10 mA, V_{CE} = 1V	20	45	150		
h_{FE}	I_C = 5 mA, V_{CE} = 10V	20	80	200		
$V_{CE(SAT)}$	I_C = 1 mA, I_B = .1 mA		0.20	0.30	V	
$V_{CE(SAT)}$	I_C = 10 mA, I_B = 1 mA		0.25	0.40	V	
$V_{BE(SAT)}$	I_C = 1 mA, I_B = .1 mA		0.75	0.85	V	
$V_{BE(SAT)}$	I_C = 10 mA, I_B = 1 mA		0.85	0.95	V	
BV_{CEO}	I_C = 3 mA	15	22		V	
BV_{CBO}	I_C = 100 μA	30	45		V	
BV_{EBO}	I_E = 10 μA	3	5.2		V	
I_{CBO}	V_{CB} = 15V			50	nA	
I_{EBO}	V_{CB} = 3V			50	nA	

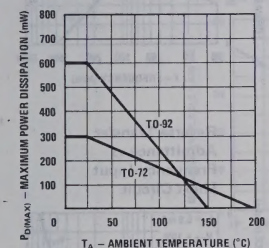
Pulsed DC Current Gain vs Collector Current



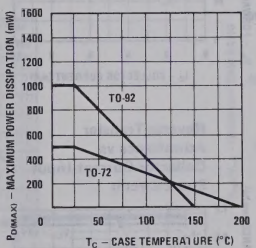
Base-Emitter On Voltage vs Collector Current



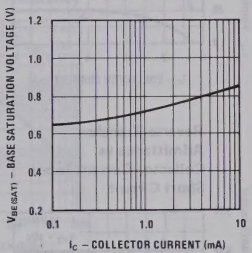
Maximum Power Dissipation vs Ambient Temperature



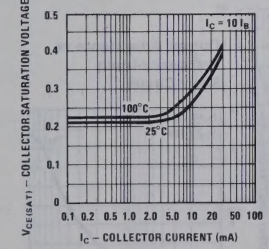
Maximum Power Dissipation vs Case Temperature



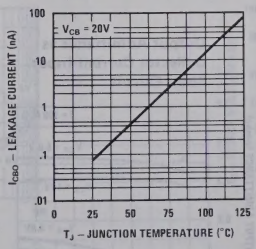
Base-Emitter Saturation Voltage vs Collector Current



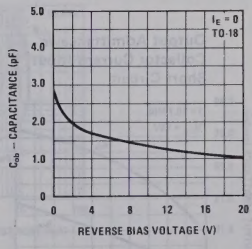
Collector Saturation Voltage vs Collector Current



Collector-Base Diode Reverse Current vs Temperature



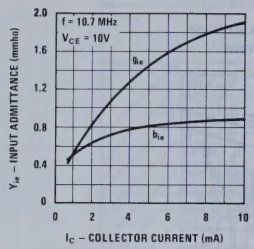
Output Capacitance vs Reverse Bias Voltage



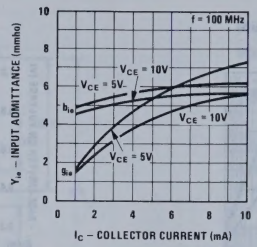
Process 43

COMMON EMITTER Y PARAMETERS VS FREQUENCY

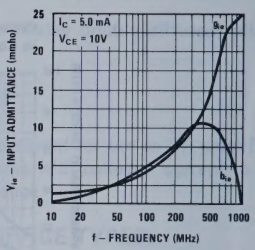
Input Admittance vs Collector Current-Output Short Circuit



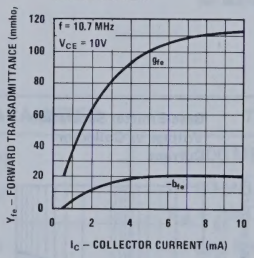
Input Admittance vs Collector Current-Output Short Circuit



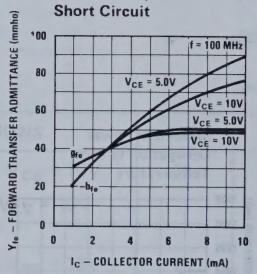
Input Admittance vs Frequency-Output Short Circuit



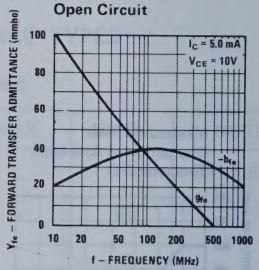
Forward Transfer Admittance vs Collector Current-Output Short Circuit



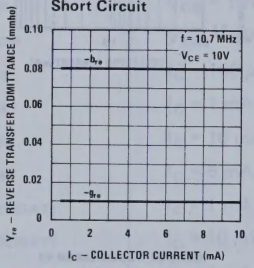
Forward Transfer Admittance vs Collector Current-Output Short Circuit



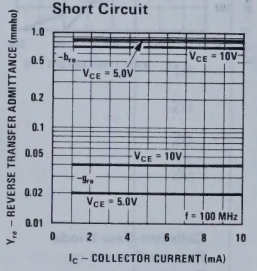
Forward Transfer Admittance vs Frequency-Output Open Circuit



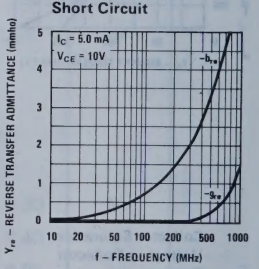
Reverse Transfer Admittance vs Collector Current-Input Short Circuit



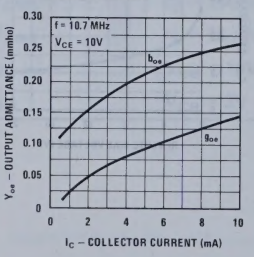
Reverse Transfer Admittance vs Collector Current-Input Short Circuit



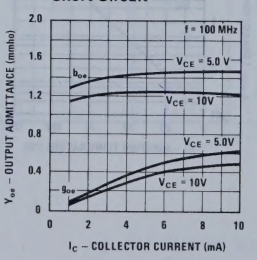
Reverse Transfer Admittance vs Frequency-Input Short Circuit



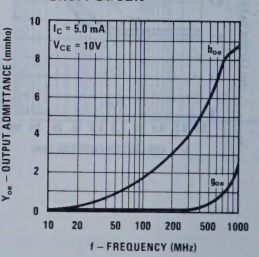
Output Admittance vs Collector Current-Input Short Circuit



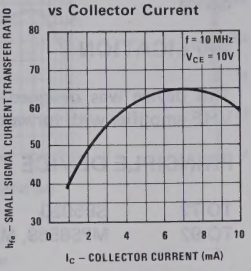
Output Admittance vs Collector Current-Input Short Circuit



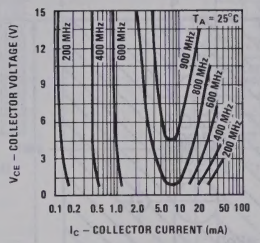
Output Admittance vs Frequency-Input Short Circuit



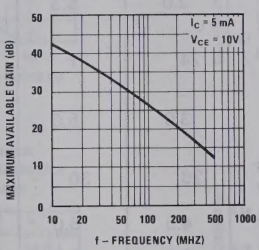
Small Signal Current Gain vs Collector Current



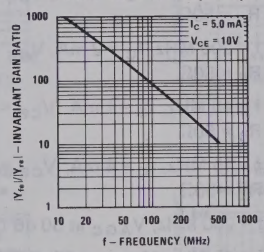
Contours of Constant Gain Bandwidth Product (f_T)



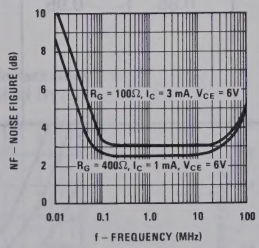
Maximum Available Gain vs Frequency



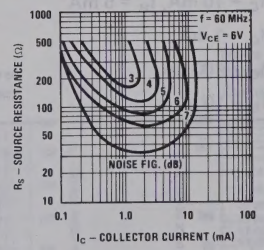
Invariant Maximum Stable Power Gain vs Frequency



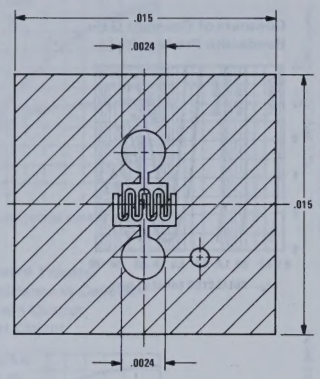
Noise Figure vs Frequency



Contours of Constant Noise Figure



Process 44 NPN AGC-RF Amplifier



DESCRIPTION

Process 44 is an overlay double diffused, silicon device.

APPLICATION

This device was designed for use as a low noise VHF amplifier with forward AGC capability.

PRINCIPLE DEVICE TYPES:

TO-72	SE5020
TO-92	MPS6568, MPS-H30 (BEC)

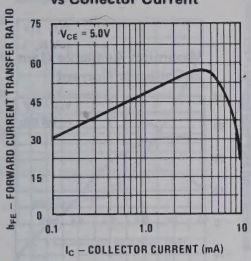
OTHER DEVICE TYPES

See pages 5 through 8.

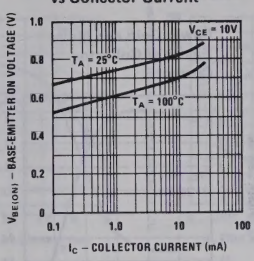
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
NF	f = 200 MHz, I_C = 2 mA, V_{CE} = 10V, R_S = 50Ω		2.0	3.3	dB	Fig. 1
P_G	f = 200 MHz, I_C = 2 mA, V_{CE} = 10V, R_S = 50Ω	20	24	27	dB	Fig. 1
NF	f = 45 MHz, I_C = 4 mA, V_{CE} = 10V, R_S = 50Ω		3.0	5.0	dB	Fig. 2
P_G	f = 45 MHz, I_C = 4 mA, V_{CE} = 10V, R_S = 50Ω	23	26	30	dB	Fig. 2
AGC	f = 200 MHz, V_{AGC} at 30 dB Down	4.0	4.5	5.0	V	Fig. 1
AGC	f = 45 MHz, V_{AGC} at 30 dB Down	4.3	5.0	5.5	V	Fig. 2
C_{cb}	V_{CB} = 10V		0.35	0.50	pF	TO-72
			0.45	0.55	pF	TO-92
h_{fe}	V_{CE} = 10V, I_C = 4 mA, f = 100 MHz	3.75	5.5	8.0		
h_{FE}	I_C = 4 mA, V_{CE} = 5V	20	60	200		
$V_{CE(SAT)}$	I_C = 10 mA, I_B = 5 mA		1.0	2.0	V	
$V_{BE(SAT)}$	I_C = 10 mA, I_B = 5 mA		0.85	0.95	V	
BV_{CEO}	I_C = 1 mA	20			V	
BV_{CBO}	I_C = 100 μA	20			V	
BV_{EBO}	I_E = 10 μA	3				

Process 44

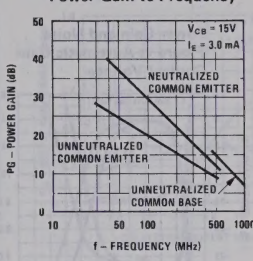
Pulsed DC Current Gain vs Collector Current



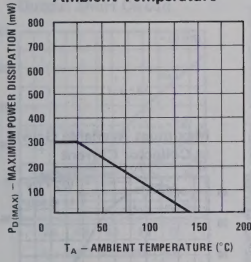
Base-Emitter On Voltage vs Collector Current



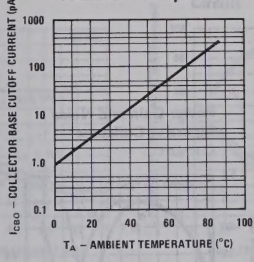
Power Gain vs Frequency



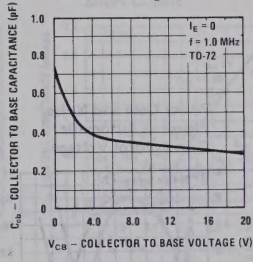
Maximum Power Dissipation vs Ambient Temperature



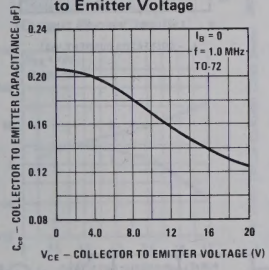
Collector Cutoff Current vs Ambient Temperature



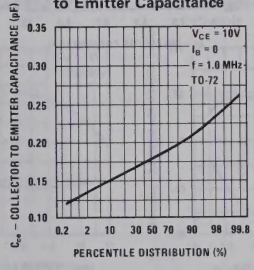
Collector to Base Capacitance vs Collector to Base Voltage



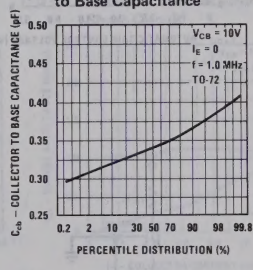
Collector to Emitter Capacitance vs Collector to Emitter Voltage



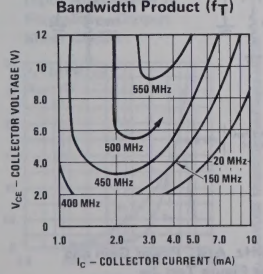
Distribution of Collector to Emitter Capacitance



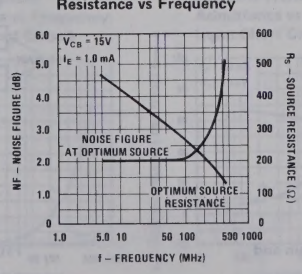
Distribution of Collector to Base Capacitance



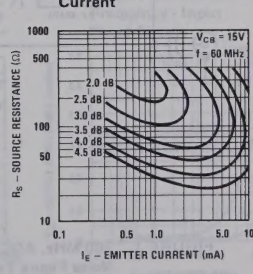
Contours of Constant Gain Bandwidth Product (f_T)



Noise Figure and Source Resistance vs Frequency


V_{CB} = 15V
I_E = 1.0 mA
NOISE FIGURE AT OPTIMUM SOURCE
OPTIMUM SOURCE RESISTANCE
NF – NOISE FIGURE (dB)
R_S – SOURCE RESISTANCE (Ω)
f – FREQUENCY (MHz)

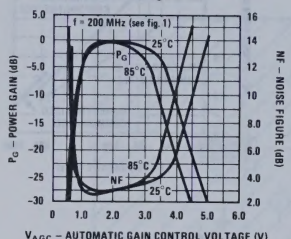
Noise Figure vs Source Resistance and Collector Current



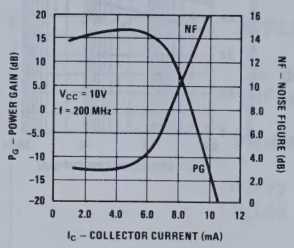
Process 44

COMMON EMITTER PERFORMANCE

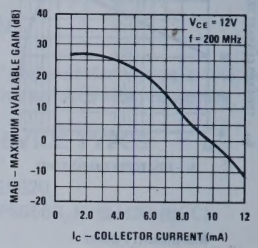
Power Gain and Noise Figure vs Automatic Gain Control Voltage



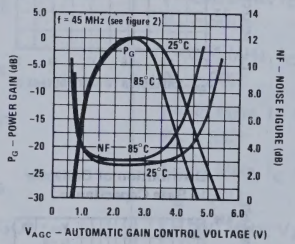
Power Gain and Noise Figure vs Collector Current



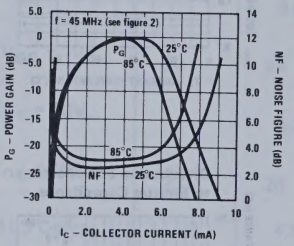
Maximum Available Gain vs Collector Current



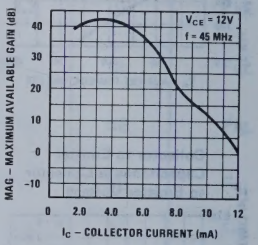
Power Gain and Noise Figure vs Automatic Gain Control Voltage



Power Gain and Noise Figure vs Collector Current



Maximum Available Gain vs Collector Current



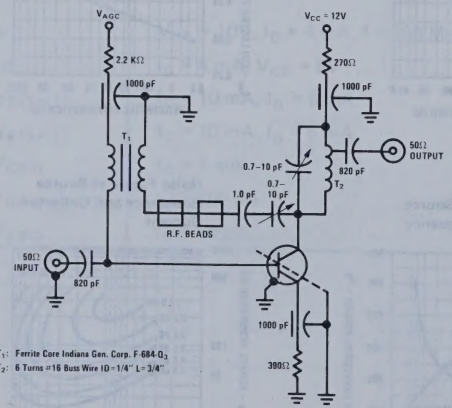


FIGURE 1. 200 MHz, AGC, Power Gain and Noise Figure Test Jig

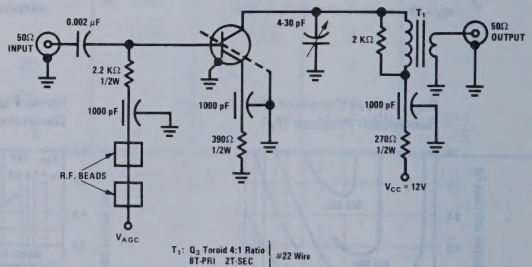
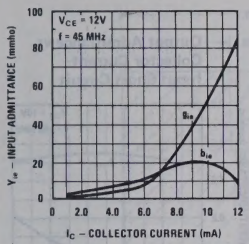


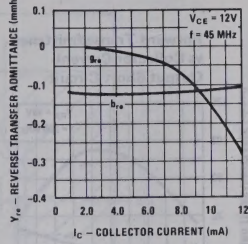
FIGURE 2. 45 MHz, AGC, Power Gain and Noise Figure Test Jig

Process 44

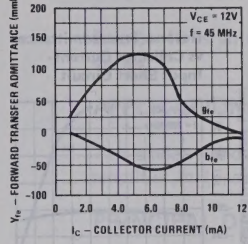
Input Admittance vs Collector Current-Output Short Circuit



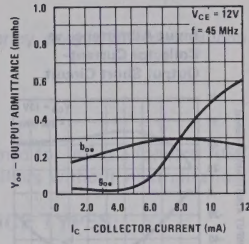
Reverse Transfer Admittance vs Collector Current-Input Short Circuit



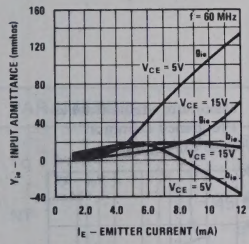
Forward Transfer Admittance vs Collector Current-Output Short Circuit



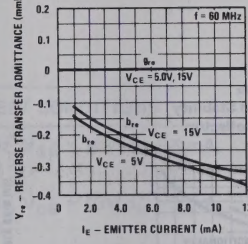
Output Admittance vs Collector Current-Input Short Circuit



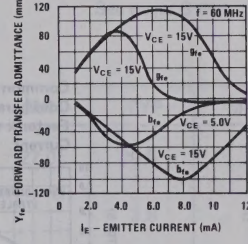
Input Admittance vs Emitter Current-Output Short Circuit



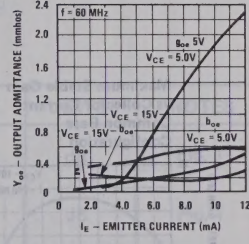
Reverse Transfer Admittance vs Emitter Current-Input Short Circuit



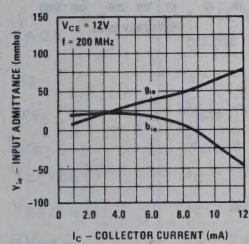
Forward Transfer Admittance vs Emitter Current-Output Short Circuit



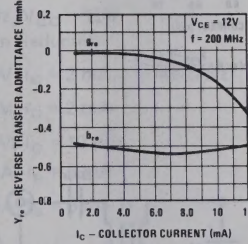
Output Admittance vs Emitter Current - Input Short Circuit



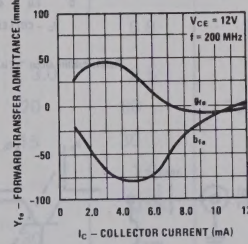
Input Admittance vs Collector Current-Output Short Circuit



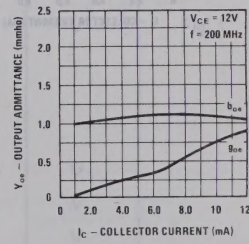
Reverse Transfer Admittance vs Collector Current-Input Short Circuit



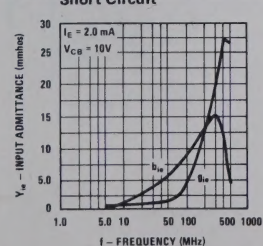
Forward Transfer Admittance vs Collector Current-Output Short Circuit



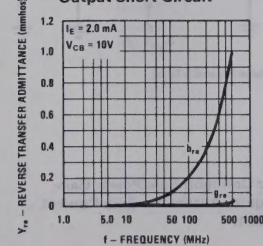
Output Admittance vs Collector Current - Input Short Circuit



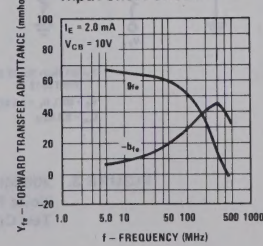
Input Admittance vs Frequency - Output Short Circuit



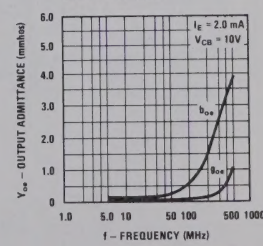
Reverse Transfer Admittance vs Frequency Output Short Circuit



Forward Transfer Admittance vs Frequency Input Short Circuit



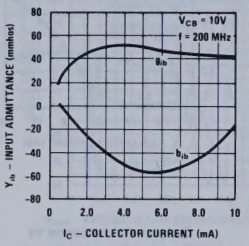
Output Admittance vs Frequency - Input Short Circuit



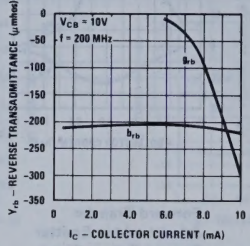
Process 44

COMMON BASE Y PARAMETERS VS FREQUENCY

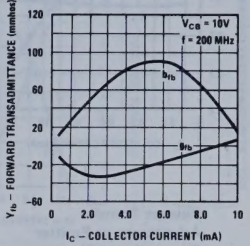
Input Admittance vs Collector Current-Output Short Circuit



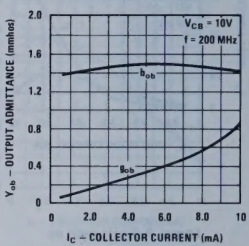
Reverse Transadmittance vs Collector Current-Input Short Circuit



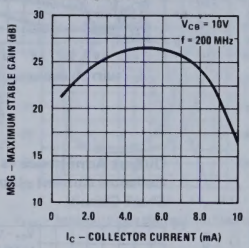
Forward Transadmittance vs Collector Current-Output Short Circuit



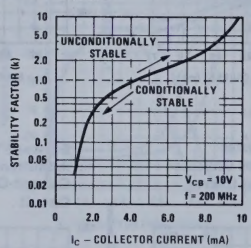
Output Admittance vs Collector Current-Input Short Circuit



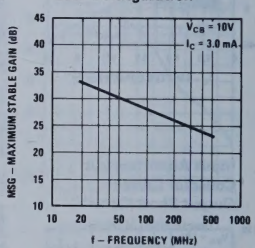
Maximum Stable Gain vs Collector Current Common Base Configuration



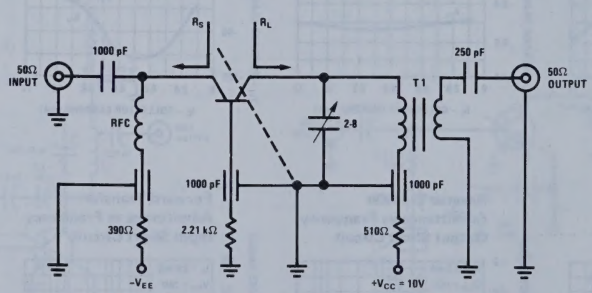
Common Base Configuration Stability Factor-k vs Collector Current



Maximum Stable Gain vs Frequency Common Base Configuration



Rollett stability factor "k" is defined as: $R = \frac{2_{gigo} - R_e (Y_f Y_r)}{|Y_f Y_r|}$



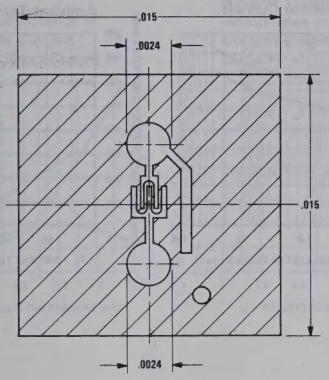
T_1–3:1 Ratio No. 22 Bifilar on Micrometals Toroid, P/N T30-12

R_S = 50Ω, R_L = 2.5 kΩ

f_{bw} = 8.0 MHz

FIGURE 3. 200 MHz Common Base Power Gain, Noise Figure, Automatic Gain Control Test Circuit.

Process 45 NPN AGC-IF Amplifier



DESCRIPTION

Process 45 is an overlay double diffused silicon device.

APPLICATION

This device was designed for use as a forward AGC amplifier in IF amplifiers without neutralization.

PRINCIPAL DEVICE TYPES:

TO-72	SE5055 (pkg 28)
TO-92	MPS-H32 (BEC)

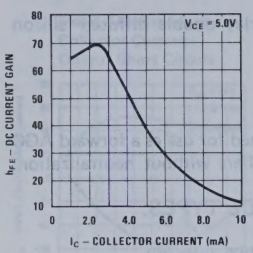
OTHER DEVICE TYPES

See pages 6 through 8.

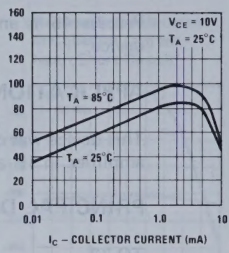
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
P_G	f = 45 MHz, V_{CE} = 10V, I_C = 3 mA, R_G = 50Ω	27.0	29.5		dB	Fig. 1
NF	f = 45 MHz, V_{CE} = 10V, I_C = 3 mA, R_G = 50Ω		2.8	5.0	dB	Fig. 1
C_{re}	V_{CB} = 10V		0.13	0.22	pF	TO-72
C_{re}	V_{CB} = 10V		0.20	0.30	pF	TO-92
V_{AGC}	f = 45 MHz, V_{CC} = 12V 30 dB Gain Reduction	3.8	4.4	5.0	V	Fig. 1
V_{AGC}	f = 45 MHz, V_{CC} = 12V 50 dB Gain Reduction		6.8	8.0	V	Fig. 1
h_{fe}	V_{CE} = 10V, I_C = 2 mA, f = 100 MHz	3.0	5.5			
h_{FE}	V_{CE} = 10V, I_C = 2 mA	20	80	200		
h_{FE}	V_{CE} = 10V, I_C = 10 mA	15	30			
$V_{CE(SAT)}$	I_C = 10 mA, I_B = 5 mA		1.0	2.0	V	
$V_{BE(SAT)}$	I_C = 10 mA, I_B = 5 mA		0.92	1.0	V	
BV_{CEO}	I_C = 1 mA	30			V	
BV_{CBO}	I_C = 100 μA	30			V	
BV_{EBO}	I_E = 10 μA	3.0			V	
I_{CBO}	V_{CB} = 20V			50	nA	

Process 45

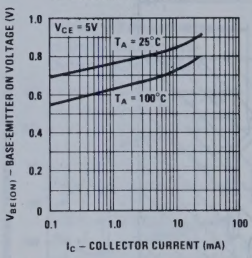
DC Current Gain vs Collector Current



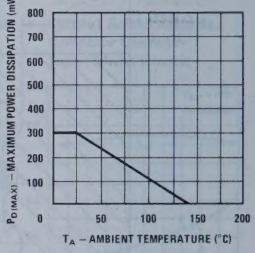
DC Pulse Current Gain vs Collector Current



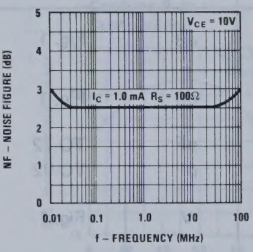
Base-Emitter On Voltage vs Collector Current



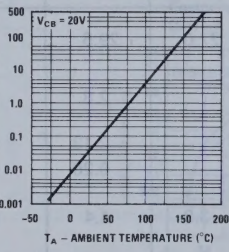
Maximum Power Dissipation vs Ambient Temperature



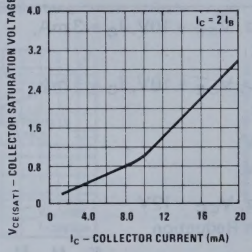
Noise Figure vs Frequency



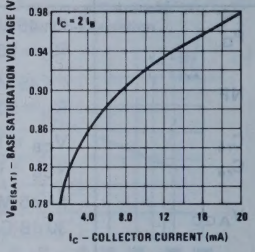
Collector Cutoff Current vs Ambient Temperature



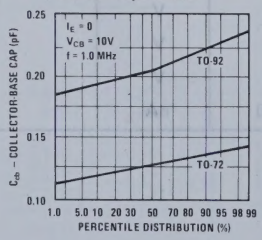
Collector Saturation Voltage vs Collector Current



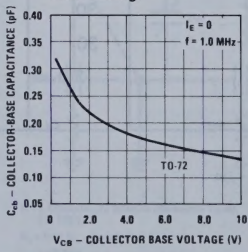
Base Saturation Voltage vs Collector Current



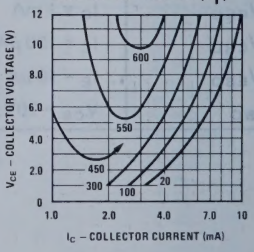
Distribution of Collector to Base Capacitance



Collector-Base Capacitance vs Collector-Base Voltage

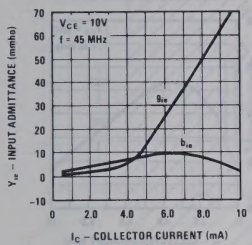


Contours of Constant Gain Bandwidth Product (f_T)

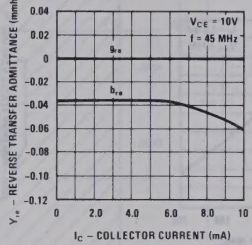


COMMON EMITTER Y PARAMETERS VS FREQUENCY

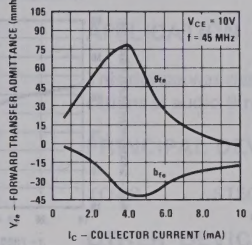
Input Admittance vs Collector Current-Output Short Circuit



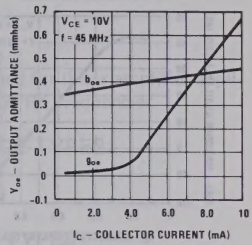
Reverse Transfer Admittance vs Collector Current–Input Short Circuit



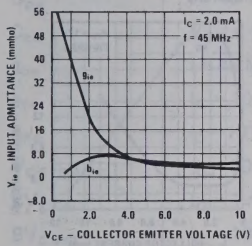
Forward Transfer Admittance vs Collector Current - Output Short Circuit



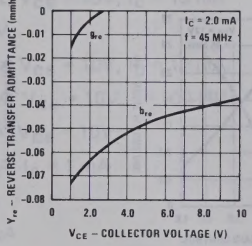
Output Admittance vs Collector Current- Input Short Circuit



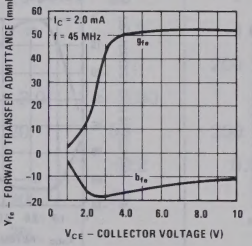
Input Admittance vs Collector Voltage- Output Short Circuit



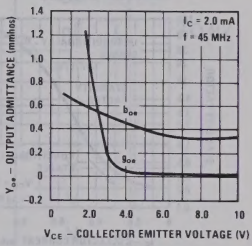
Reverse Transfer Admittance vs Collector Voltage - Input Short Circuit



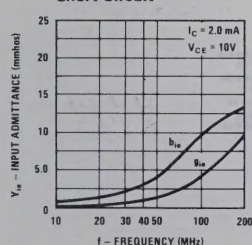
Forward Transfer Admittance vs Collector Voltage—Output Short Circuit



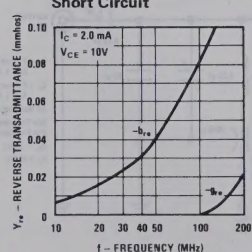
Output Admittance vs Collector Voltage- Input Short Circuit



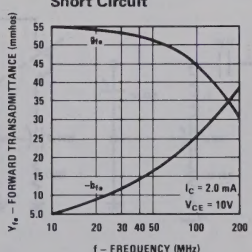
Input Admittance vs Frequency - Output Short Circuit



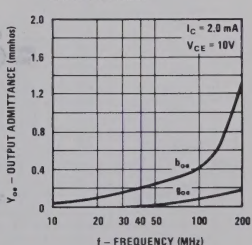
Reverse Transadmittance vs Frequency - Input Short Circuit



Forward Transadmittance vs Frequency - Output Short Circuit



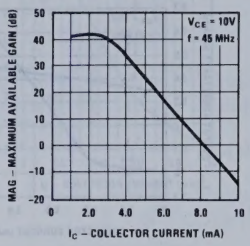
Output Admittance vs Frequency - Input Short Circuit



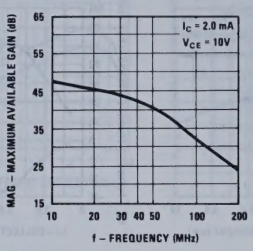
Process 45

COMMON EMITTER PERFORMANCE

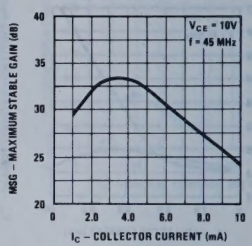
Maximum Available Gain vs Collector Current



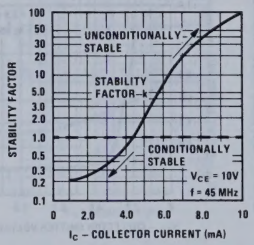
Maximum Available Gain vs Frequency



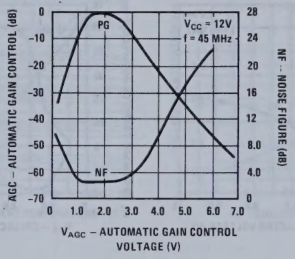
Maximum Stable Gain vs Collector Current



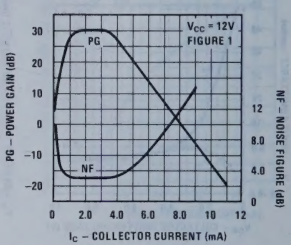
Stability Factor* vs Collector Current



Automatic Gain Control and Noise Figure vs Automatic Gain Control Voltage



Power Gain and Noise Figure vs Collector Current



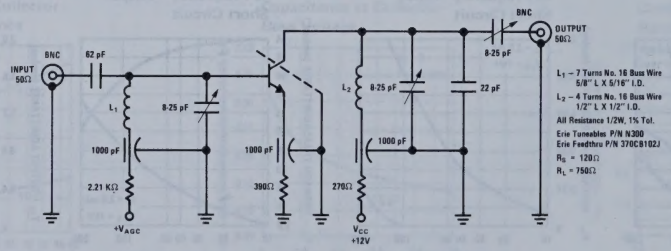
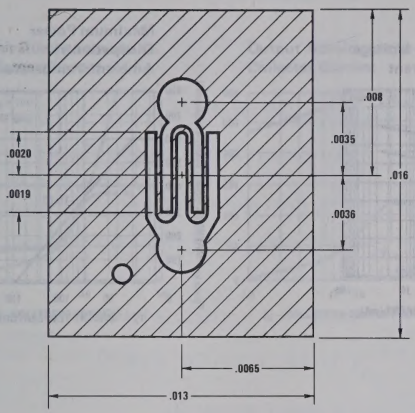


FIGURE 1. SE5055 45 MHz Gain, Noise Figure, AGC Circuit

* Rollett stability factor "k" is defined as: $R = \frac{2_{SISO} - R_e (Y_f Y_r)}{|Y_f Y_r|}$

Process 46 NPN RF-IF Amplifier



DESCRIPTION

Process 46 is an overlay double diffused, silicon epitaxial device.

APPLICATION

This device was designed for linear amplifier applications at audio through RF frequencies.

PRINCIPAL DEVICE TYPES:

TO-92 ST5025

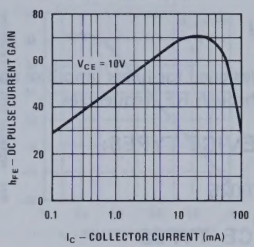
OTHER DEVICE TYPES

See pages 7 and 8.

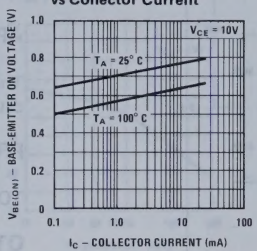
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
G_{pe}	f = 45 MHz, V_{CE} = 10V, I_C = 10 mA	25	28		dB	
C_{cb}	V_{CB} = 10V		0.8	1.0	pF	TO-92
g_{oe}	f = 45 MHz, V_{CE} = 10V, I_C = 10 mA			200	μmho	
h_{fe}	I_C = 10 mA, V_{CE} = 10V, f = 100 MHz	3.0	4.50			
h_{FE}	I_C = 10 mA, V_{CE} = 10V	20	50	200		
$V_{CE(SAT)}$	I_C = 20 mA, I_B = 1 mA		0.2	0.6	V	
BV_{CEO}	I_C = 1 mA	30	60		V	
BV_{CBO}	I_C = 100 μA	30			V	
BV_{EBO}	I_C = 10 μA	3.0			V	
I_{CBO}	V_{CB} = 30V			50	nA	
I_{EBO}	V_{EB} = 2V			50	nA	

Process 46

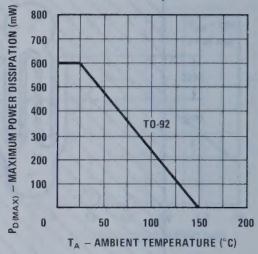
DC Pulse Current Gain vs Collector Current



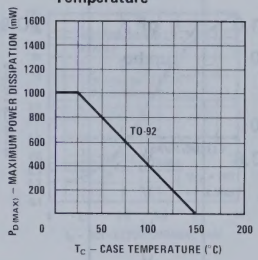
Base-Emitter On Voltage vs Collector Current



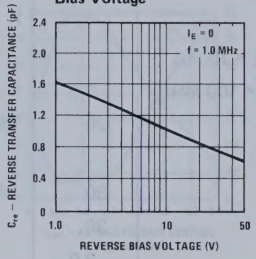
Maximum Power Dissipation vs Ambient Temperature



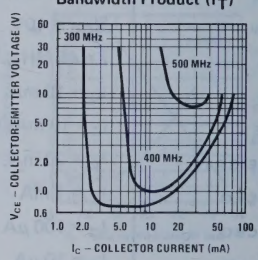
Maximum Power Dissipation vs Case Temperature



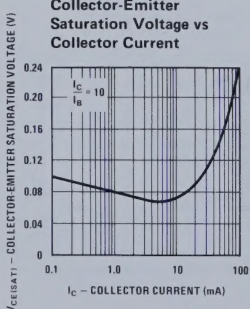
Reverse Transfer Capacitance vs Reverse Bias Voltage



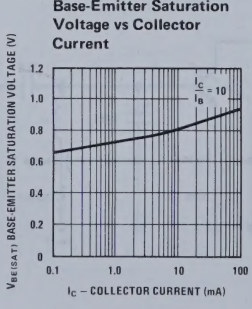
Contours of Constant Gain Bandwidth Product (f_T)



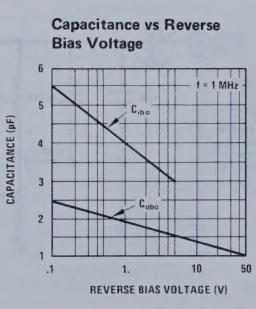
Collector-Emitter Saturation Voltage vs Collector Current



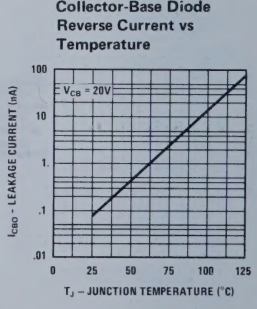
Base-Emitter Saturation Voltage vs Collector Current



Capacitance vs Reverse Bias Voltage

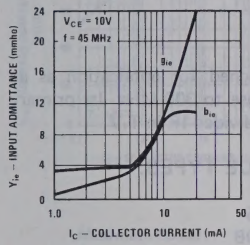


Collector-Base Diode Reverse Current vs Temperature

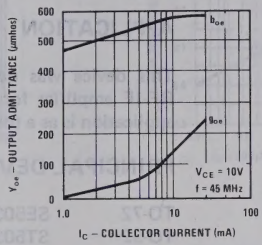


Process 46

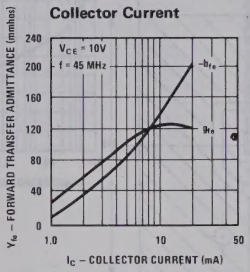
Input Admittance vs Collector Current



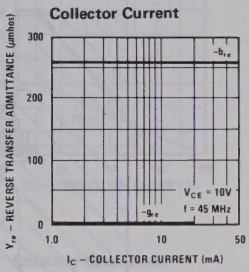
Output Admittance vs Collector Current



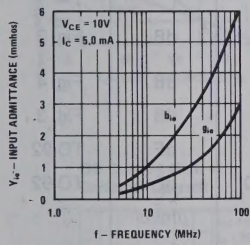
Forward Transfer Admittance vs Collector Current



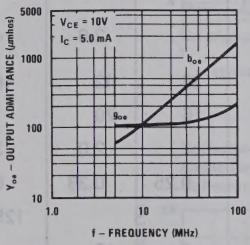
Reverse Transfer Admittance vs Collector Current



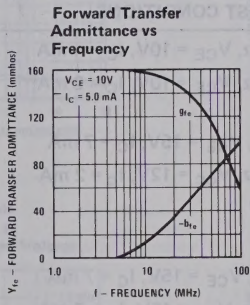
Input Admittance vs Frequency



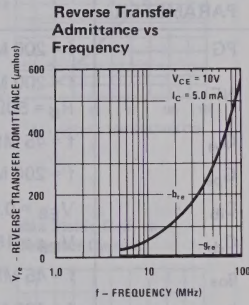
Output Admittance vs Frequency



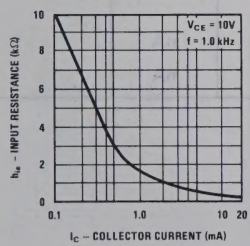
Forward Transfer Admittance vs Frequency



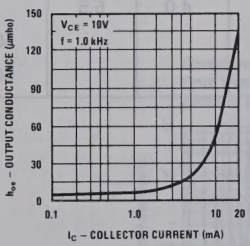
Reverse Transfer Admittance vs Frequency



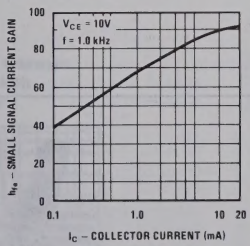
Small Signal Input Resistance vs Collector Current



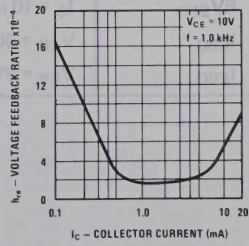
Small Signal Output Conductance vs Collector Current



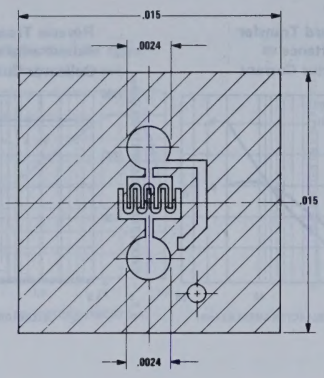
Small Signal Current Gain vs Collector Current



Small Signal Voltage Feedback Ratio vs Collector Current



Process 47 NPN RF-IF Amplifier



DESCRIPTION

Process 47 is an overlay double diffused, silicon epitaxial device, with a Faraday shield diffusion.

APPLICATION

This device was designed for application as an RF-IF amplifier for use to 300 MHz. Its primary application is as a third video IF in T.V.

PRINCIPAL DEVICE TYPES:

TO-72	SE5035
TO-92	ST5030B

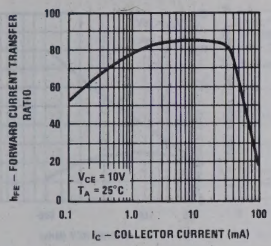
OTHER DEVICE TYPES

See pages 5 through 8.

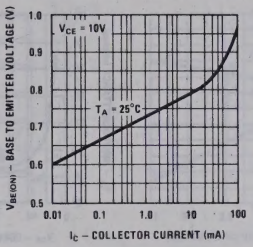
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
PG	f = 200 MHz, V_{CE} = 10V, I_C = 4 mA	22	25		dB	Fig. 2
NF	f = 200 MHz, V_{CE} = 10V, I_C = 2 mA, R_S = 50Ω		2.0	4.0	dB	Fig. 3
G_{ve}	f = 45 MHz, V_{CE} = 15V, I_C = 7 mA	38	42	46	dB	Fig. 4
G_{pe}	f = 200 MHz, V_{CC} = 12V, I_C = 2 mA	16	20		dB	Fig. 3
C_{ib}	V_{EB} = 0.5V		2.0	3.0	pF	TO-92
C_{cb}	V_{CB} = 15V	0.25	0.33	0.40	pF	TO-92
g_{oe}	f = 45 MHz, V_{CE} = 15V, I_C = 7 mA			125	μmho	
h_{fe}	f = 100 MHz, V_{CE} = 15V, I_C = 7 mA	6	10			
h_{FE}	V_{CE} = 15V, I_C = 7 mA	40	80	200		
$V_{CE(SAT)}$	I_C = 20 mA, I_B = 1 mA		0.3	1.0	V	
$V_{BE(SAT)}$	I_C = 10 mA, I_B = 5 mA		0.85	0.92	V	
BV_{CEO}	I_C = 10 mA	30	45		V	
BV_{CBO}	I_C = 100 μA	40	55		V	
BV_{EBO}	I_E = 10 μA	4.0	5.5			
I_{CBO}	V_{CB} = 30V			50	nA	
I_{EBO}	V_{EB} = 3V			50	nA	

Process 47

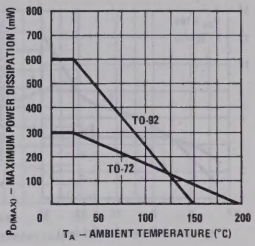
DC Pulse Current Gain vs Collector Current



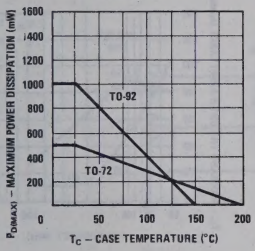
Base-Emitter On Voltage vs Collector Current



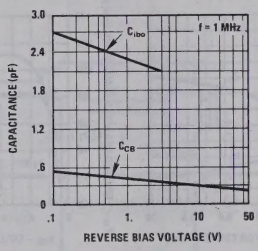
Maximum Power Dissipation vs Ambient Temperature



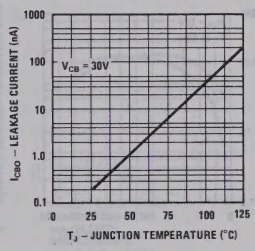
Maximum Power Dissipation vs Case Temperature



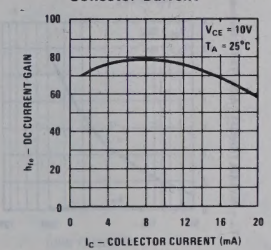
Capacitance vs Reverse Bias Voltage



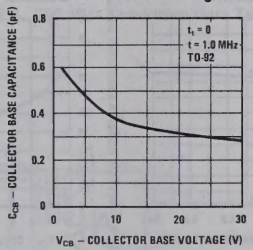
Collector-Base Diode Reverse Current vs Temperature



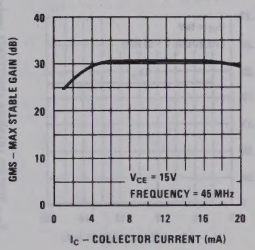
DC Current Gain vs Collector Current



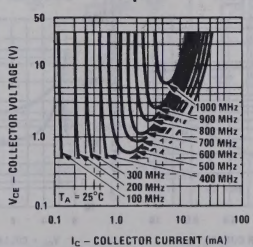
Collector-Base Capacitance vs Collector-Base Voltage



Max Stable Gain vs Collector Current



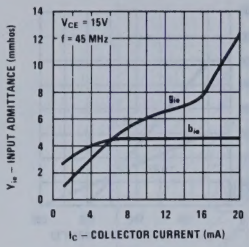
Contours of Constant Gain Bandwidth Product (f_T)



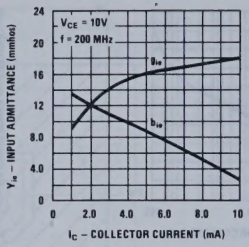
Process 47

COMMON EMITTER VS FREQUENCY Y PARAMETERS

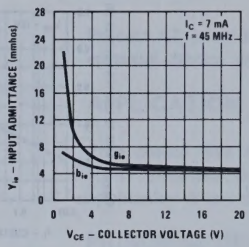
Input Admittance vs Collector Current



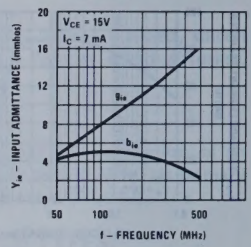
Input Admittance vs Collector Current



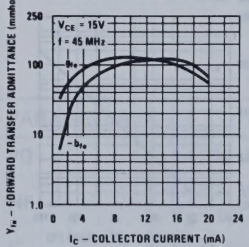
Input Admittance vs Collector Voltage



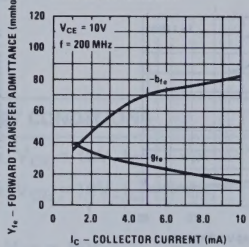
Input Admittance vs Frequency



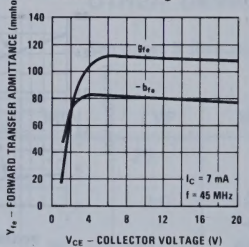
Forward Transfer Admittance vs Collector Current



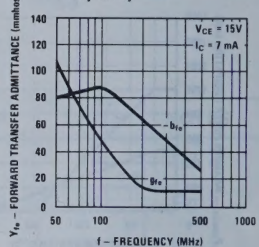
Forward Transfer Admittance vs Collector Current



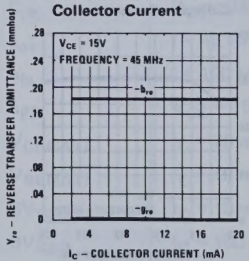
Forward Transfer Admittance vs Collector Voltage



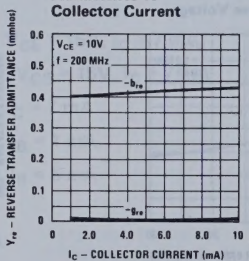
Forward Transfer Admittance vs Frequency



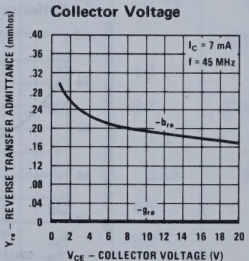
Reverse Transfer Admittance vs Collector Current



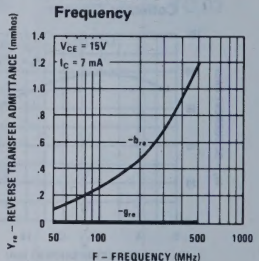
Reverse Transfer Admittance vs Collector Current



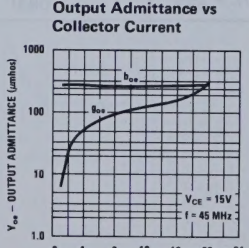
Reverse Transfer Admittance vs Collector Voltage



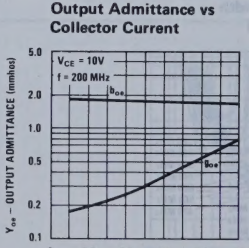
Reverse Transfer Admittance vs Frequency



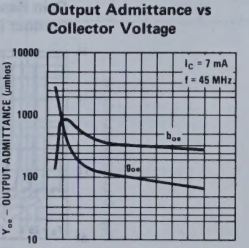
Output Admittance vs Collector Current



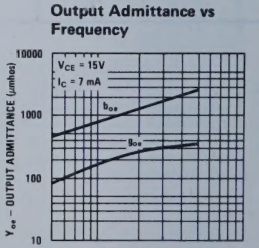
Output Admittance vs Collector Current



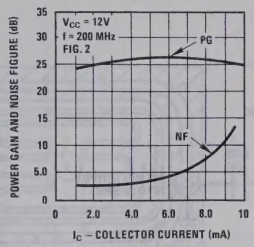
Output Admittance vs Collector Voltage



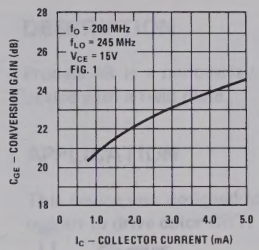
Output Admittance vs Frequency

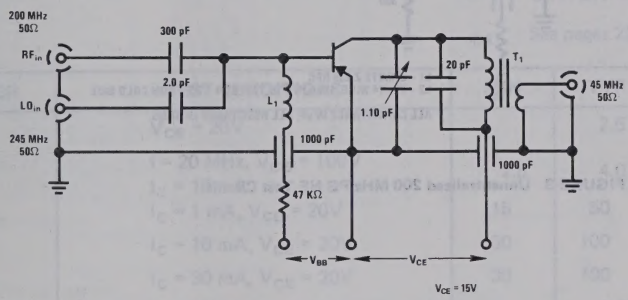


Power Gain and Noise Figure vs Collector Current



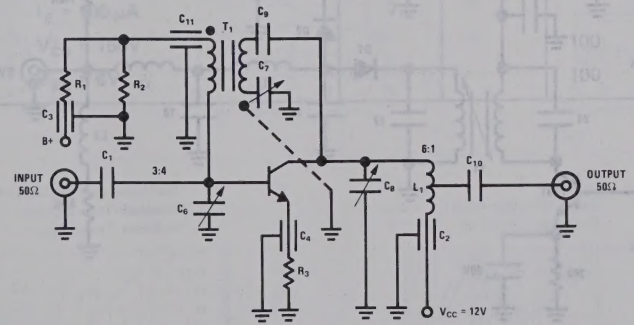
Conversion Gain vs Collector Current





L1 – Ohmite RFC Z235
T1 – Primary 5 turns #34 wire ¼" dia.
Secondary 2 turns #34 wire close wound over a Q100 core (10.7 MHz)
When terminated on secondary side with 50Ω, primary measures 1.5k, –25 pF.

FIGURE 1. 200 MHz Conversion Gain Test Circuit



C_1, C_{10} = 1000 pF Duramica
C_2, C_3, C_4, C_5, C_{11} = 1000 pF feed thru
C_6 = 8 - 25 pF
C_7, C_8 = 0.7 - 10 pF
C_9 = 2 pF Duramica

R_1 = 10 kΩ
R_2 = 2 kΩ
R_3 = 270Ω
L_1 = 5 turns #14 wire, 5/16" I.D. x 1" long

T_1 = 1 turn #14 wire– primary
1 turn #16 wire enamel, secondary. Wound on Balun form Ferrite core Indiana Gen. Corp. F-684-Q3

FIGURE 2. 200 MHz Power Gain Test Circuit

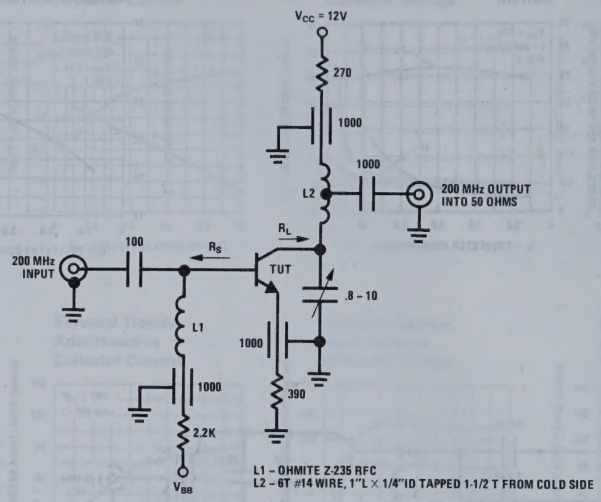


FIGURE 3. Unneutralized 200 MHz PG NF Test Circuit

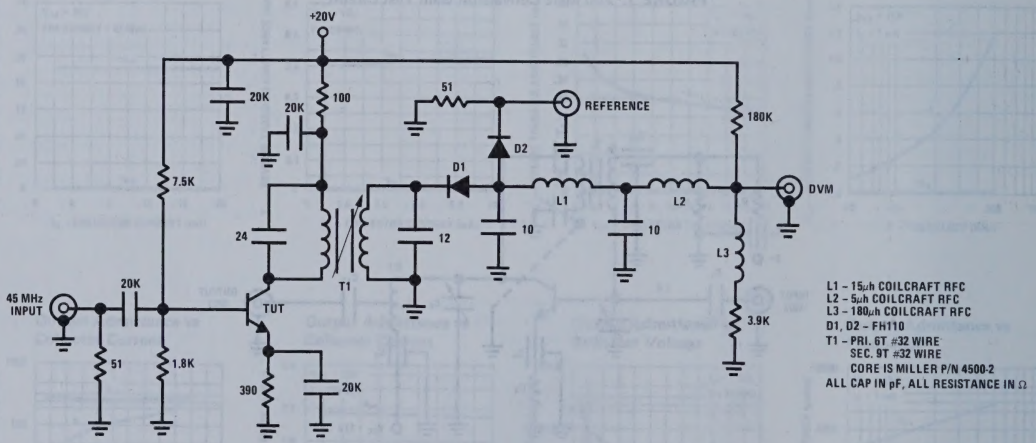
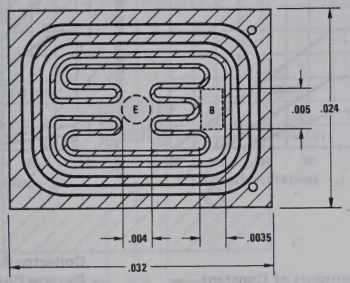


FIGURE 4. 45 MHz Voltage Gain (Gve) Circuit

Process 48 NPN High Voltage Video Output



DESCRIPTION

Process 48 is a nonoverlay triple diffused, silicon device with a field plate.

APPLICATION

This device was designed for application as a video output to drive color CRT.

PRINCIPAL DEVICE TYPES:

TO-39	SE7056
TO-202	SP7056

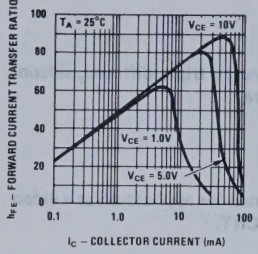
OTHER DEVICE TYPES

See pages 22, 27 and 28.

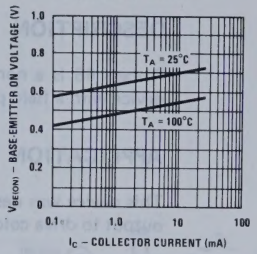
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
C_{cb}	V_{CB} = 20V		2.5	3.5	pF	TO-39
h_{fe}	f = 20 MHz, V_{CE} = 100V I_C = 15 mA	2.5	4.0			
h_{FE}	I_C = 1 mA, V_{CE} = 20V	15	50			
h_{FE}	I_C = 10 mA, V_{CE} = 20V	30	100			
h_{FE}	I_C = 30 mA, V_{CE} = 20V	30	100			
$V_{CE(SAT)}$	I_C = 20 mA, I_B = 2 mA		0.35	1.0	V	
$V_{BE(SAT)}$	I_C = 20 mA, I_B = 2 mA		0.74	0.85	V	
C_{eb}	V_{EB} = 0.5V		45	70	pF	
BV_{CEO}	I_C = 5 mA	220	320	500	V	
BV_{CBO}	I_C = 100 μA	220	420	700	V	
BV_{EBO}	I_E = 100 μA	7.0			V	
I_{CBO}	V_{CB} = 150V			100	nA	
I_{EBO}	V_{EB} = 6V			100	nA	

Process 48

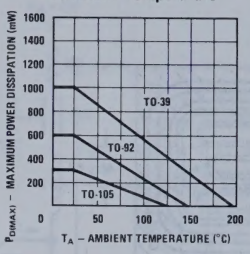
DC Pulse Current Gain vs Collector Current



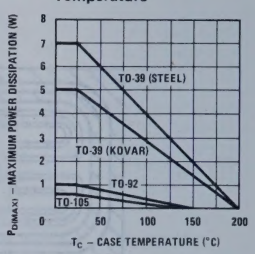
Base-Emitter On Voltage vs Collector Current



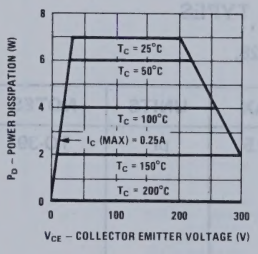
Maximum Power Dissipation vs Ambient Temperature



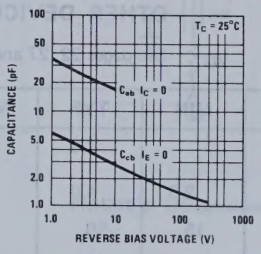
Maximum Power Dissipation vs Case Temperature



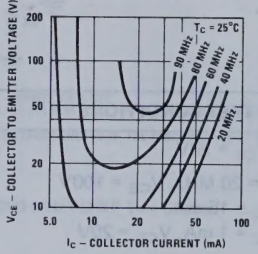
Guaranteed Maximum DC Power Dissipation vs Collector-Emitter Voltage, TO-39



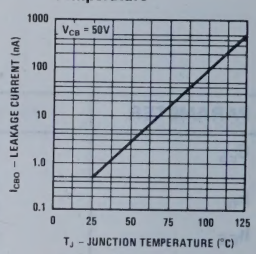
Collector to Base and Emitter to Base Capacitance vs Reverse Bias Voltage



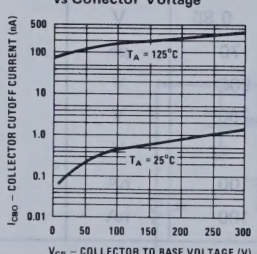
Contours of Constant Gain Bandwidth Product



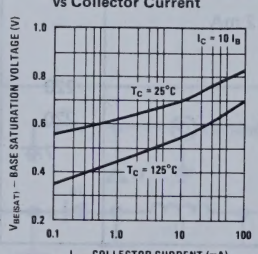
Collector-Base Diode Reverse Current vs Temperature



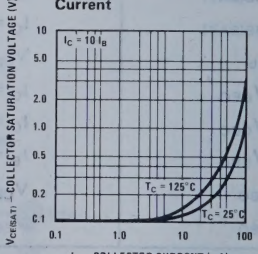
Collector Cutoff Current vs Collector Voltage



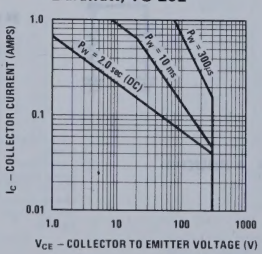
Base Saturation Voltage vs Collector Current



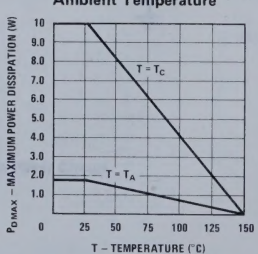
Collector Saturation Voltage vs Collector Current



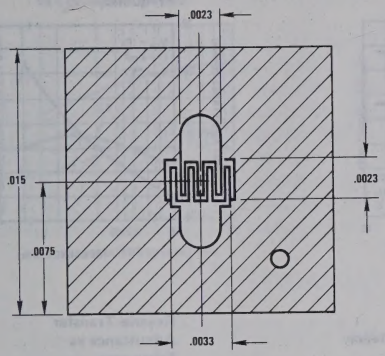
Safe Operating Area Durawatt, TO-202



Maximum Power Dissipation Durawatt vs Case and Ambient Temperature



Process 49 NPN RF Amplifier



DESCRIPTION

Process 49 is an overlay double diffused silicon epitaxial device.

APPLICATION

This device was designed for general RF amplifier applications to 250 MHz.

PRINCIPAL DEVICE TYPES:

TO-92 (BEC) MPS6544, MPSH20

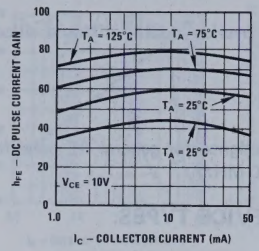
OTHER DEVICE TYPES

See pages 5 and 7.

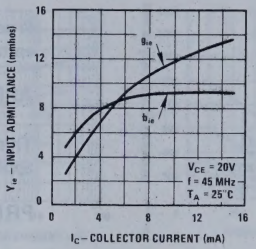
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
PG	f = 45 MHz, V_{CE} = 10V, I_C = 10 mA	25	30		dB	
f_t	V_{CE} = 10V, I_C = 10 mA	400	700		MHz	
rb'Cc	f = 31.9 MHz, V_{CE} = 10V, I_C = 8 mA		6.5	20.0	ps	TO-92
Ccb	f = 1.0 MHz, V_{CB} = 10V, I_E = 0		0.55	0.65	pF	TO-92
h_{FE}	V_{CE} = 10V, I_C = 30 mA	25	75			
h_{FE}	V_{CE} = 10V, I_C = 4 mA	25				
$V_{BE(ON)}$	V_{CE} = 10V, I_C = 10 mA		0.80	0.95	V	
$V_{CE(SAT)}$	I_C = 30 mA, I_C = 3 mA		0.15	0.50	V	
g_{oe}	f = 45 MHz, V_{CE} = 10V, I_C = 10 mA			100	μmhos	
roep	f = 4.5 MHz, V_{CE} = 10V, I_C = 2 mA	80k			Ω	
BV_{CEO}	I_C = 1 mA	40	55		V	
BV_{CBO}	I_C = 100 μA	45	75		V	
BV_{EBO}	I_E = 10 μA	4.0	5.5		V	
I_{CBO}	V_{CB} = 30V			50	nA	
I_{EBO}	V_{EB} = 3.0V			50	nA	

Process 49

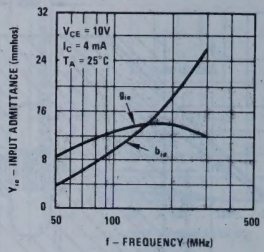
DC Pulse Current Gain vs Collector Current



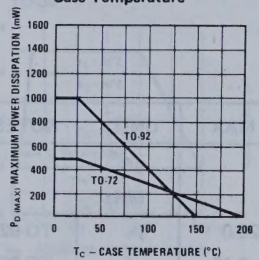
Input Admittance vs Collector Current



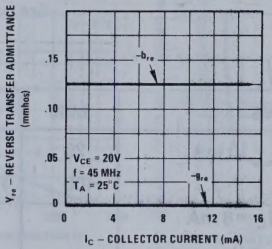
Input Admittance vs Frequency



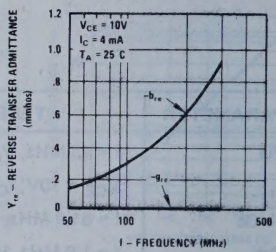
Maximum Power Dissipation vs Case Temperature



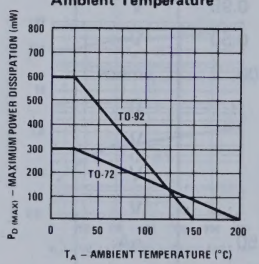
Reverse Transfer Admittance vs Collector Current



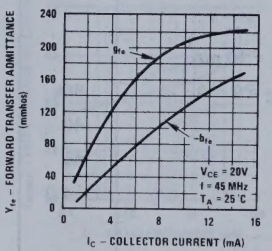
Reverse Transfer Admittance vs Frequency



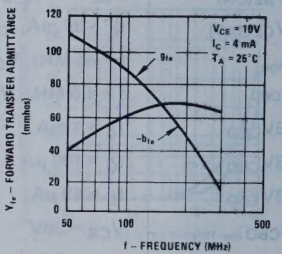
Maximum Power Dissipation vs Ambient Temperature



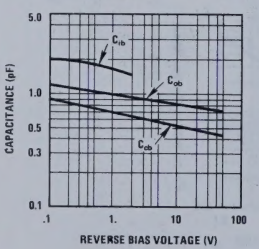
Forward Transfer Admittance vs Collector Current



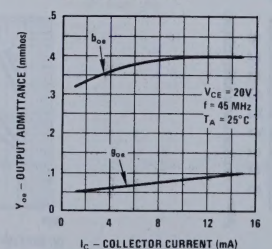
Forward Transfer Admittance vs Frequency



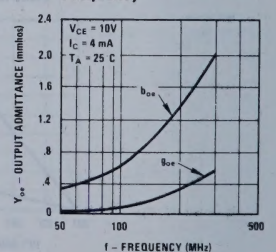
Capacitance vs Reverse Bias Voltage



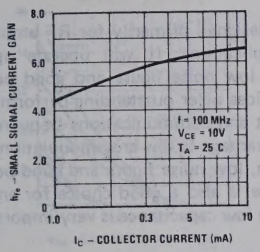
Output Admittance vs Collector Current



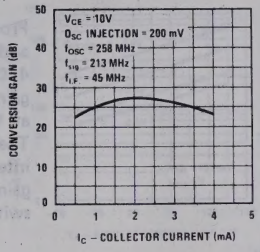
Output Admittance vs Frequency



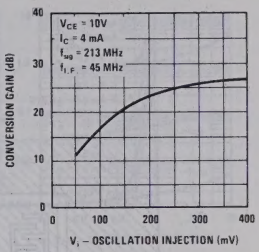
Small Signal Current Gain vs Collector Current



Conversion Gain vs Collector Current



Conversion Gain vs Oscillator Injection Level



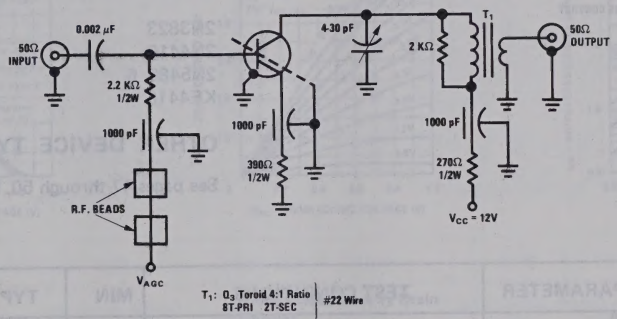


FIGURE 1. 45 MHz Power Gain Circuit

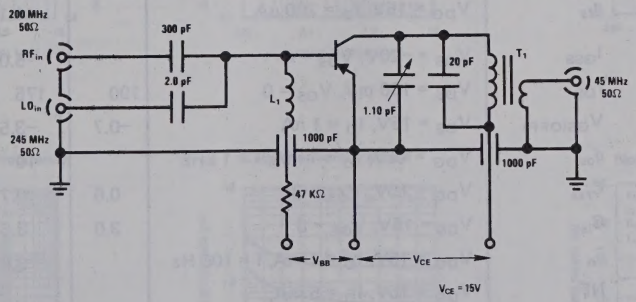
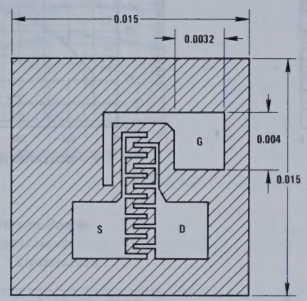


FIGURE 2. 200 MHz Conversion Gain Test Circuit

Process 50 N-Channel Junction FET



GATE IS ALSO BACKSIDE CONTACT

DESCRIPTION

Process 50 is designed primarily for RF amplifier and mixer applications. It will operate up to 450 MHz with low noise figure and good power gain. These devices offer outstanding performance at VHF aircraft and communications frequencies. Their major advantage is low crossmodulation and intermodulation, low noise figure and good power gain. The device is also a good choice for analog switching where low capacitance is very important.

PACKAGES:

TO-72, TO-92, TO-106

PRINCIPAL DEVICE TYPES:

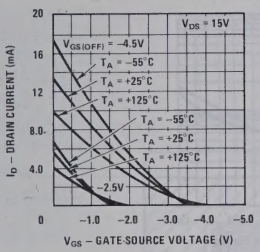
2N3823
2N4416
2N5485, 6
KE4416

OTHER DEVICE TYPES

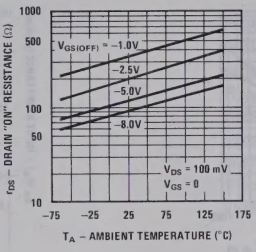
See pages 47 through 50, 52 and 53.

CHARACTERISTIC	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Gate-Source Breakdown Voltage	BV_{GSS}	V_{DS} = 0V, I_G = −1 μA	−25	−40	−50	V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = 15V, V_{GS} = 0V	1.0	10	20	mA
Forward Trans-conductance	g_{fs}	V_{DS} = 15V, V_{GS} = 0	3.0	5.5	7.0	mmhos
Forward Trans-conductance	g_{fs}	V_{DG} = 15V, I_D = 200 μA		1.1		mmhos
Reverse Gate Leakage	I_{GSS}	V_{GS} = −20V, V_{DS} = 0		−5.0	−100	pA
"ON" Resistance	r_{DS}	V_{DS} = 100 mV, V_{GS} = 0	100	175	500	Ω
Pinch Off Voltage	$V_{GS(OFF)}$	V_{DS} = 15V, I_D = 1 nA	−0.7	−3.5	−6.0	V
Output Conductance	g_{os}	V_{DG} = 15V, I_D = 1 mA, f = 1 kHz		10		μmhos
Feedback Capacitance	C_{rss}	V_{DG} = 15V, V_{GS} = 0	0.6	0.7	0.9	pF
Input Capacitance	C_{iss}	V_{DS} = 15V, V_{GS} = 0	3.0	3.5	4.0	pF
Noise Voltage	$\bar{e}_n$	V_{DG} = 15V, I_D = 1 mA, f = 100 Hz		8.0		$nV/\sqrt{Hz}$
Noise Figure	NF	V_{DG} = 15V, I_D = 5 mA, R_G = 1 kΩ, f = 400 MHz		2.2	4.0	dB
Power Gain	G_{PS}	V_{DG} = 15V, I_D = 5 mA, f = 400 MHz	10	12		dB

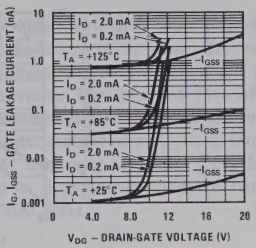
Transfer Characteristics



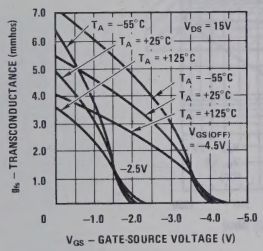
Channel Resistance vs Temperature



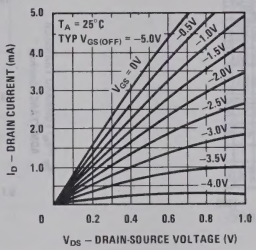
Leakage Current vs Voltage



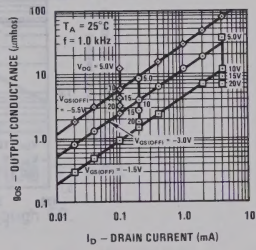
Transconductance Characteristics



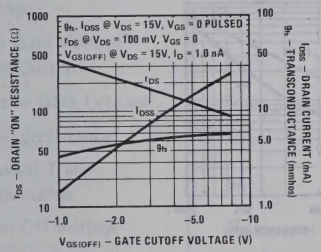
Common Drain-Source Characteristics



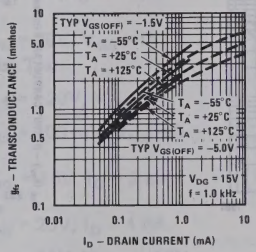
Output Conductance vs Drain Current



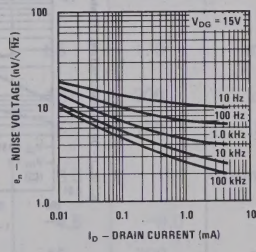
Parameter Interactions


g_{fs}, I_{DSS} @ V_{DS} = 15V, V_{GS} = 0 PULSED
r_{DS} @ V_{DS} = 100 mV, V_{GS} = 0
$V_{GS(OFF)}$ @ V_{DS} = 15V, I_D = 1.0 nA
r_{DS}
I_{DSS}
g_{fs}
r_{DS} – DRAIN "ON" RESISTANCE (Ω)
I_{DSS} – DRAIN CURRENT (mA)
g_{fs} – TRANSCONDUCTANCE (mmhos)
$V_{GS(OFF)}$ – GATE CUTOFF VOLTAGE (V)

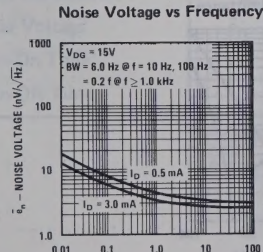
Transconductance vs Drain Current



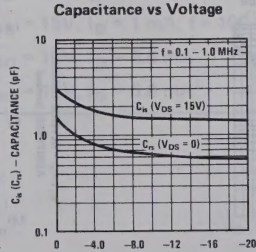
Noise Voltage vs Current



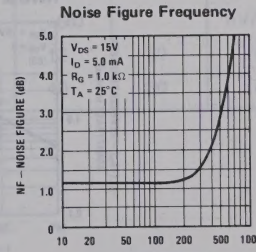
Noise Voltage vs Frequency



Capacitance vs Voltage



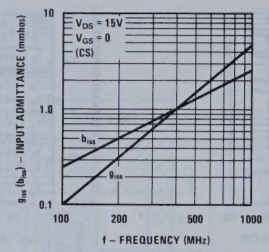
Noise Figure Frequency



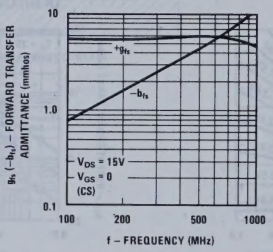
Process 50

COMMON SOURCE

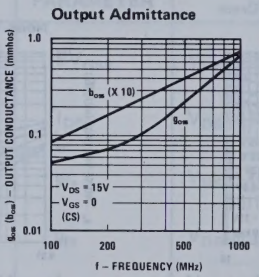
Input Admittance



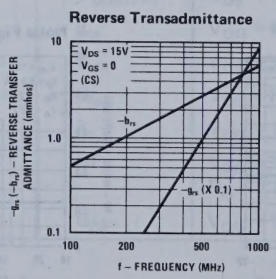
Forward Transadmittance



Output Admittance

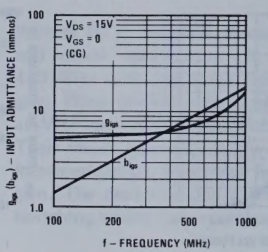


Reverse Transadmittance

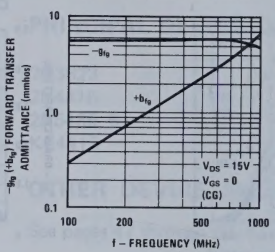


COMMON GATE

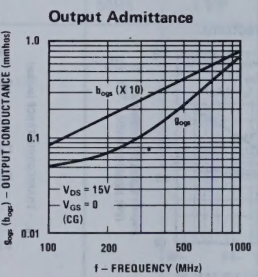
Input Admittance



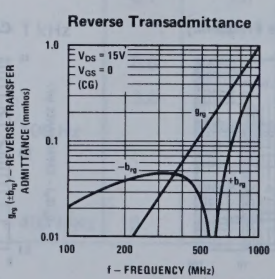
Forward Transadmittance



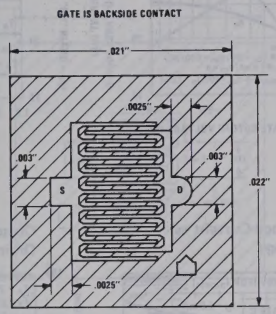
Output Admittance



Reverse Transadmittance



Process 51 N-Channel Junction FET



DESCRIPTION

Process 51 is designed primarily for electronic switching applications such as low ON resistance analog switching. It features excellent C_{iss} $R_{DS(ON)}$ time constant. The inherent zero offset voltage and low leakage current make these devices excellent for chopper stabilized amplifiers, sample and hold circuits, and reset switches. Low feedthrough capacitance also allows them to handle video signals to 100 MHz.

PACKAGES:

TO-18, TO-92, TO-106

PRINCIPAL DEVICE TYPES:

2N4091-93
2N4391-93
2N4856-61
2N5638, 39, 40
KE 4391, 92, 93

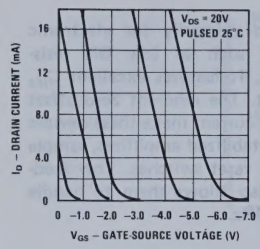
OTHER DEVICE TYPES

See pages 47 through 50.

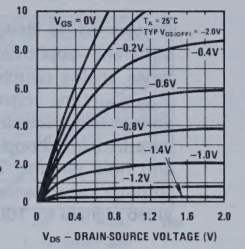
CHARACTERISTIC	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Gate-Source Breakdown Voltage	BV_{GSS}	V_{DS} = 0V, I_G = −1 μA	−30	−50	−65	V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = 20V, V_{GS} = 0 Pulse Test	5.0	65	170	mA
Reverse Gate Leakage	I_{GSS}	V_{GS} = −20V, V_{DS} = 0		−15	−200	pA
"ON" Resistance	r_{DS}	V_{DS} = 100 mV, V_{GS} = 0	20	35	100	Ω
Forward Transconductance	g_{fs}	V_{DG} = 15V, I_D = 2 mA		8.5		mmhos
Pinch Off Voltage	$V_{GS(OFF)}$	V_{DS} = 20V, I_D = 1 nA	−0.5	−4.5	−9.0	V
Drain "OFF" Current	$I_{D(OFF)}$	V_{DS} = 20V, V_{GS} = −10V		15	200	pA
Feedback Capacitance	C_{rss}	V_{DG} = 15V, I_D = 5 mA, f = 1 MHz	3.0	3.5	4.0	pF
Input Capacitance	C_{iss}	V_{DS} = 15V, I_D = 5 mA, f = 1 MHz	10	12	16	pF
Noise Voltage	$\bar{e}_n$	V_{DG} = 15V, I_D = 1 mA, f = 100 Hz		6.0		$nV/\sqrt{Hz}$
Turn-On Time	t_{on}	V_{DD} = 10V, I_D = 6.6 mA		12	20	ns
Turn-Off Time	t_{off}	V_{DD} = 10V, I_D = 6.6 mA		40	80	ns

Process 51

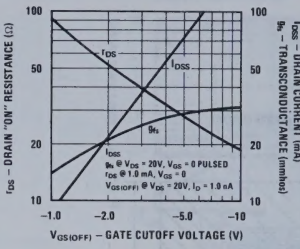
Drain Current vs Bias Voltage



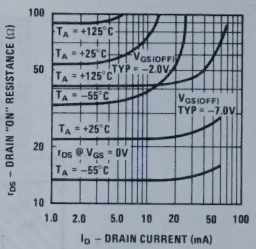
Common Drain-Source Characteristics



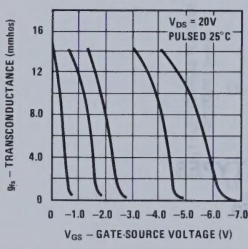
Parameter Interactions


r_{DS}
I_{DSS}
g_{fs}
r_{DS} @ V_{GS} = 20V, V_{DS} = 0 PULSED
r_{DS} @ 1.0 mA, V_{GS} = 0
$V_{GS(OFF)}$ @ V_{DS} = 20V, I_D = 1.0 nA
r_{DS} – DRAIN "ON" RESISTANCE (Ω)
I_{DSS} – DRAIN CURRENT (mA)
g_{fs} – TRANSCONDUCTANCE (mmhos)
$V_{GS(OFF)}$ – GATE CUTOFF VOLTAGE (V)

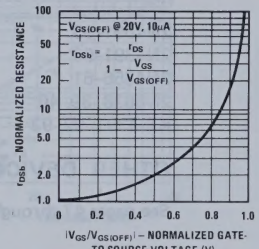
Resistance vs Drain Current



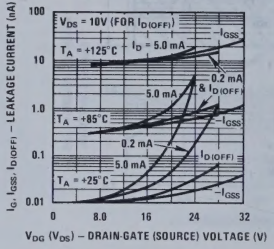
Transconductance vs Bias Voltage



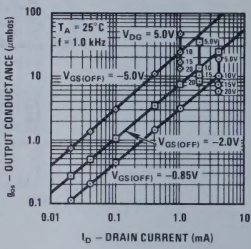
Normalized Drain Resistance vs Bias Voltage


$V_{GS(OFF)}$ @ 20V, 10μA
$r_{DSb} = \frac{r_{DS}}{1 - \frac{V_{GS}}{V_{GS(OFF)}}}$
r_{DSb} – NORMALIZED RESISTANCE
$|V_{GS}/V_{GS(OFF)}|$ – NORMALIZED GATE-TO-SOURCE VOLTAGE (V)

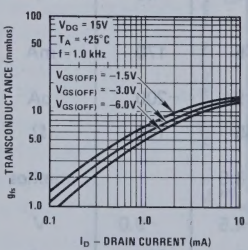
Leakage Current vs Voltage



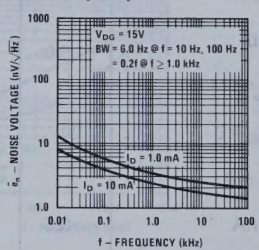
Output Conductance vs Drain Current



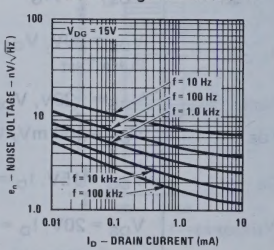
Transconductance vs Drain Current



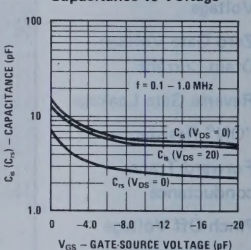
Noise Voltage vs Frequency



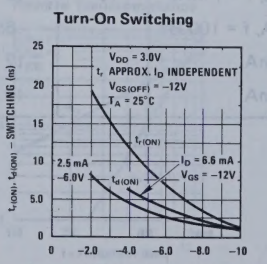
Noise Voltage vs Current



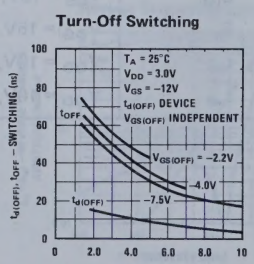
Capacitance vs Voltage



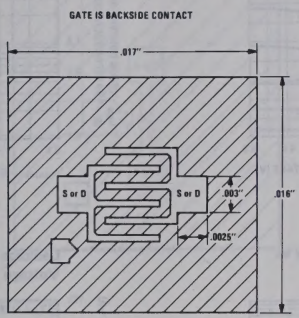
Turn-On Switching



Turn-Off Switching



Process 52 N-Channel Junction FET



DESCRIPTION

Process 52 is designed primarily for low level audio and general purpose applications. These devices provide excellent performance as input stages for piezo electric transducers or other high impedance signal sources. Their high output impedance and high voltage breakdown lend them to high gain audio and video amplifier applications. Source and drain are interchangeable.

PACKAGES:

TO-18, TO-72, TO-92, TO-106

PRINCIPAL DEVICE TYPES:

2N4338, 39, 40, 41
2N3684, 85, 86, 87
2N4302-04
2N5716-18

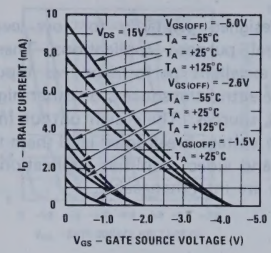
OTHER DEVICE TYPES

See pages 51 through 53.

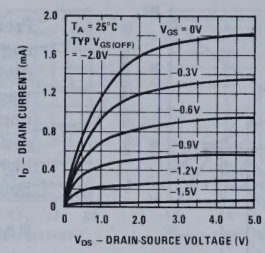
CHARACTERISTIC	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Gate-Source Breakdown Voltage	BV_{GSS}	V_{DS} = 0V, I_G = −1 μA	−50	−100	−130	V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = 20V, V_{GS} = 0	0.1	3.0	10.0	mA
Forward Transconductance	g_{fs}	V_{DS} = 20V, V_{GS} = 0	0.5	1.8	3.0	mmhos
Forward Transconductance	g_{fs}	V_{DS} = 15V, I_D = 200 μA		550		μmhos
Reverse Gate Leakage	I_{GSS}	V_{GS} = −30V, V_{DS} = 0		−10	−100	pA
"ON" Resistance	r_{DS}	V_{DS} = 100 mV, V_{GS} = 0	300	500	2000	Ω
Pinch Off Voltage	$V_{GS(OFF)}$	V_{DS} = 20V, I_D = 1 nA	−0.5	−3.0	−8.0	V
Feedback Capacitance	C_{rss}	V_{DG} = 15V, V_{GS} = 0, f = 1 MHz	0.8	1.2	1.5	pF
Input Capacitance	C_{iss}	V_{DS} = 15V, V_{GS} = 0, f = 1 MHz	3.0	4.0	5.0	pF
Output Conductance	g_{os}	V_{DG} = 15V, I_D = 200 μA		2.0		μmhos
Noise Voltage	$\tilde{e}_n$	V_{DG} = 15V, I_D = 500 μA		25		$nV/\sqrt{Hz}$

Process 52

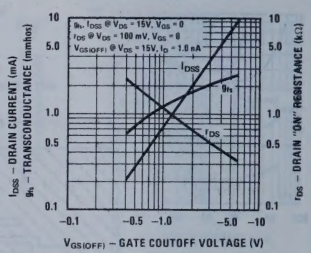
Transfer Characteristics



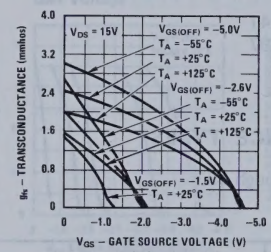
Common Drain-Source Characteristics



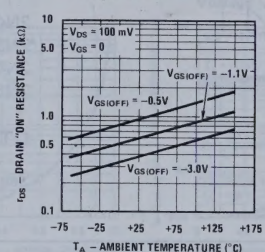
Parameter Interactions


g_{fs}, I_{DSS} @ V_{DG} = 15V, V_{GS} = 0
r_{DS} @ V_{DS} = 100 mV, V_{GS} = 0
$V_{GS(OFF)}$ @ V_{DS} = 15V, I_D = 1.0 nA
I_{DSS}
g_{fs}
r_{DS}
I_{DSS} – DRAIN CURRENT (mA)
g_{fs} – TRANSCONDUCTANCE (mmhos)
r_{DS} – DRAIN "ON" RESISTANCE (kΩ)
$V_{GS(OFF)}$ – GATE COUTOFF VOLTAGE (V)

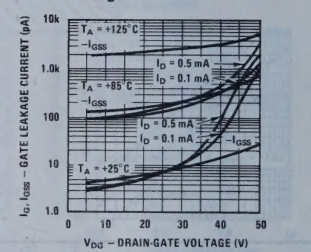
Transfer Characteristics



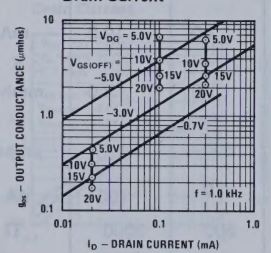
Channel Resistance vs Temperature



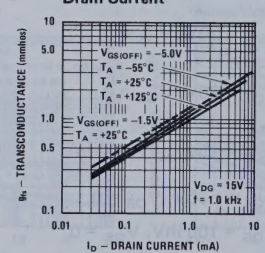
Leakage Current vs Voltage



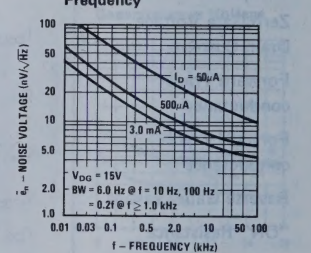
Output Conductance vs Drain Current



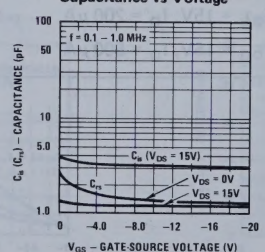
Transconductance vs Drain Current



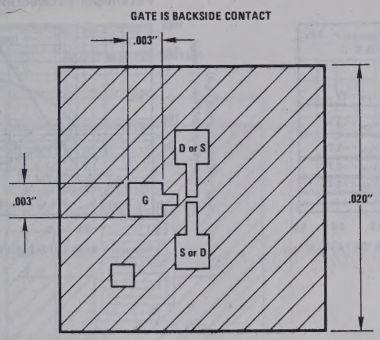
Noise Voltage vs Frequency



Capacitance vs Voltage



Process 53 N-Channel Junction FET



DESCRIPTION

Process 53 is designed primarily for low current DC and audio applications. These devices provide excellent performance as input stages for sub pico-amp instrumentation or any high impedance signal sources.

PACKAGES:

TO-18, TO-72

PRINCIPAL DEVICE TYPES:

2N3089
2N3452-54
2N4117-19
2N4117A-19A

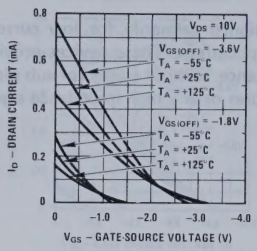
OTHER DEVICE TYPES

See page 51.

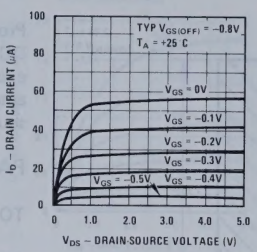
CHARACTERISTIC	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Gate-Source Breakdown Voltage	BV_{GSS}	V_{DS} = 0V, I_G = −1 μA	−40	−60	−80	V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = 10V, V_{GS} = 0	0.02	0.25	1.0	mA
Forward Trans-conductance	g_{fs}	V_{DS} = 10V, V_{GS} = 0	80	250	350	μmho
Forward Trans-conductance	g_{fs}	V_{DG} = 15V, I_D = 50 μA		120		μmho
Reverse Gate Leakage	I_{GSS}	V_{GS} = −20V, V_{DS} = 0		−0.3	−10	pA
Pinch Off Voltage	$V_{GS(OFF)}$	V_{DS} = 10V, I_D = 1 nA	−0.5	−2.2	−6.0	V
Feedback Capacitance	C_{rss}	V_{DG} = 15V, V_{GS} = 0, f = 1 MHz	0.7	0.85	1.0	pF
Input Capacitance	C_{iss}	V_{DS} = 15V, V_{GS} = 0, f = 1 MHz	1.7	2.0	2.5	pF
Output Conductance	g_{os}	V_{DG} = 10V, I_D = 50 μA		0.9	5.0	μmhos
Noise Voltage	$\bar{e}n$	V_{DG} = 10V, I_D = 50 μA, f = 100 Hz		45	150	$nV/\sqrt{Hz}$

Process 53

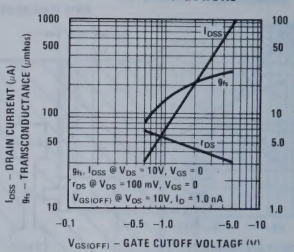
Transfer Characteristics



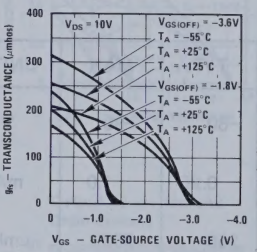
Common Drain-Source Characteristics



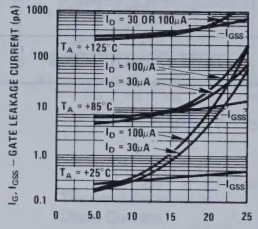
Parameter Interactions


I_{DSS}
g_{fs}
r_{DS}
g_{fs}, I_{DSS} @ V_{DS} = 10V, V_{GS} = 0
r_{DS} @ V_{DS} = 100 mV, V_{GS} = 0
$V_{GS(OFF)}$ @ V_{DS} = 10V, I_D = 1.0 nA
I_{DSS} – DRAIN CURRENT (μA)
g_{fs} – TRANSCONDUCTANCE (μmhos)
r_{DS} – DRAIN "ON"-RESISTANCE (kΩ)
$V_{GS(OFF)}$ – GATE CUTOFF VOLTAGE (V)

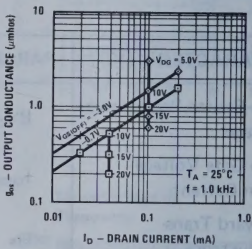
Transfer Characteristics



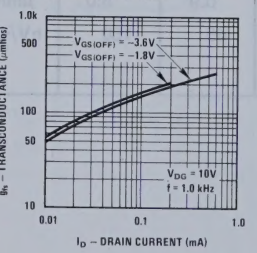
Leakage Current vs Voltage



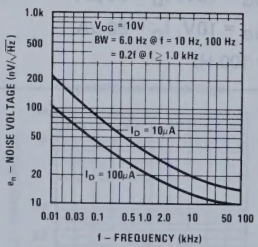
Output Conductance vs Drain Current



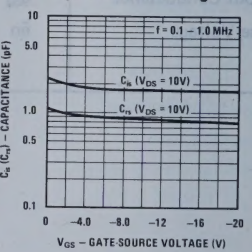
Transconductance vs Drain Current



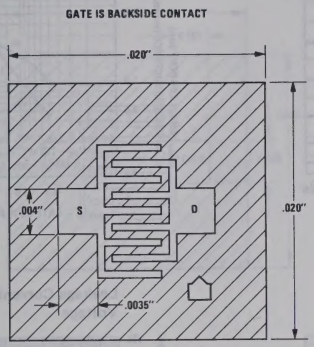
Noise Voltage vs Frequency



Capacitance vs Voltage



Process 55 N-Channel Junction FET



DESCRIPTION

Process 55 is a general purpose low level audio amplifier and switching transistor. Wafer processing is similar to process 52 but process 55 uses a larger geometry. This results in higher Y_{fs}, I_{DSS}, and capacitance and lower $R_{DS(ON)}$. It is useful for audio and video frequency amplifiers and RF amplifiers under 50 MHz. It may also be used for analog switching applications.

PACKAGES:

TO-18, TO-72, TO-92, TO-106

PRINCIPAL DEVICE TYPES:

2N4221-22
2N5457, 58, 59
2N5361-64

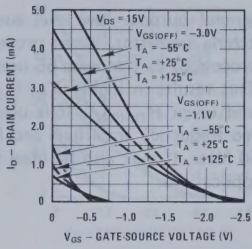
OTHER DEVICE TYPES

See pages 47, and 51 through 53.

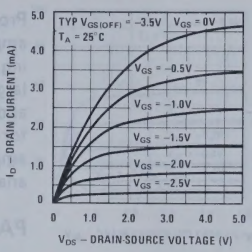
CHARACTERISTIC	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Gate-Source Breakdown Voltage	BV_{GSS}	V_{DS} = 0V, I_G = −1 μA	−50	−100	−150	V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = 20V, V_{GS} = 0	0.5	5.0	17	mA
Forward Transconductance	g_{fs}	V_{DS} = 20V, V_{GS} = 0	0.8	3.5	5.0	mmho
Forward Transconductance	g_{fs}	V_{DG} = 15V, I_D = 200 μA		750		μmhos
Reverse Gate Leakage	I_{GSS}	V_{GS} = −30V, V_{DS} = 0		−10	−100	pA
"ON" Resistance	r_{DS}	V_{DS} = 100 mV, V_{GS} = 0	150	350	800	Ω
Pinch Off Voltage	$V_{GS(OFF)}$	V_{DS} = 20V, I_D = 1 nA	−0.5	−3.0	−8.0	V
Feedback Capacitance	C_{rss}	V_{DG} = 15V, V_{GS} = 0, f = 1 MHz	1.0	1.5	2.0	pF
Input Capacitance	C_{iss}	V_{DS} = 15V, V_{GS} = 0, f = 1 MHz	4.0	5.5	7.0	pF
Output Conductance	g_{os}	V_{DG} = 15V, I_D = 200 μA		4.0		μmhos
Noise Voltage	$\bar{e}_n$	V_{DG} = 15V, I_D = 200 μA, f = 100 Hz		30		$nV/\sqrt{Hz}$

Process 55

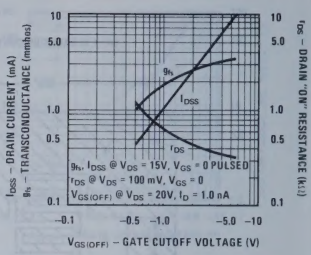
Transfer Characteristics



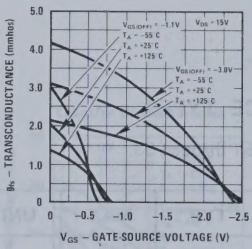
Common Drain-Source Characteistics



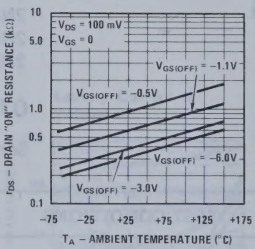
Parameter Interactions


g_{fs}
I_{DSS}
r_{DS}
g_{fs}, I_{DSS} @ V_{DS} = 15V, V_{GS} = 0 PULSED
r_{DS} @ V_{DS} = 100 mV, V_{GS} = 0
$V_{GS(OFF)}$ @ V_{DS} = 20V, I_D = 1.0 nA
I_{DSS} – DRAIN CURRENT (mA)
g_{fs} – TRANSCONDUCTANCE (mmhos)
r_{DS} – DRAIN "ON" RESISTANCE (kΩ)
$V_{GS(OFF)}$ – GATE CUTOFF VOLTAGE (V)

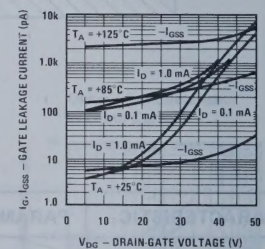
Transfer Characteristics



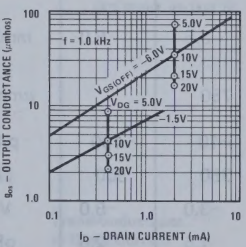
Channel Resistance vs Temperature



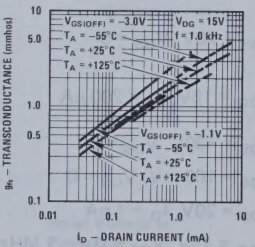
Leakage Current vs Voltage



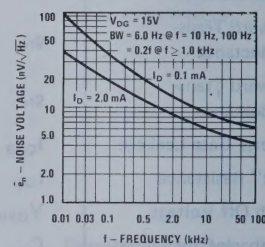
Output Conductance vs Drain Current



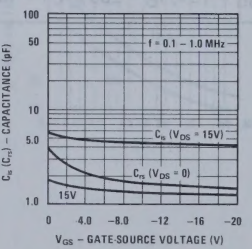
Transconductance vs Drain Current



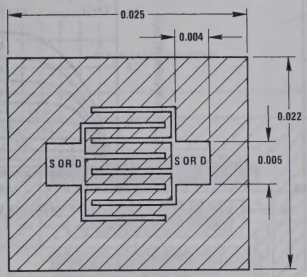
Noise Voltage vs Frequency



Capacitance vs Voltage



Process 57 N-Channel Junction FET



DESCRIPTION

Process 57 is specifically designed for minimal noise at $\leq$ 100 Hz. Even at 10 Hz, the excess noise is rising only 2 dB/octave. Product is desirous where input impedance reaches only a few Kohm. One series features 10 nV/$\sqrt{Hz}$ max at 10 Hz.

PACKAGES:

TO-72

PRINCIPAL DEVICE TYPES:

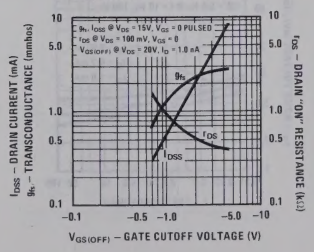
2N4867-9
2N4867A-9A

OTHER DEVICE TYPES

See page 50.

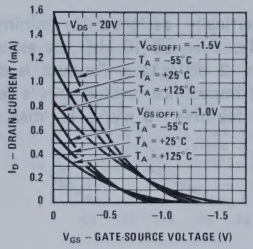
CHARACTERISTIC	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Gate-Source Breakdown Voltage	BV_{GSS}	V_{DS} = 0V, I_G = −1 μA	−40	−60	−80	V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = 20V, V_{GS} = 0	0.2	3.0	10	mA
Forward Transconductance	g_{fs}	V_{DS} = 20V, V_{GS} = 0	0.4	2.5	4.0	mmhos
Pinch Off Voltage	$V_{GS(OFF)}$	V_{DS} = 20V, I_D = 1 mA	−0.6	−2.5	−6.0	V
Forward Transconductance	g_{fs}	V_{DG} = 20V, I_D = 0.2 mA		650		μmhos
Output Conductance	g_{os}	V_{DG} = 20V, I_D = 0.2 mA		0.15		μmhos
"ON" Resistance	r_{DS}	V_{DS} = 100 mV, V_{GS} = 0		500		Ω
Gate Leakage	I_{GSS}	V_{GS} = −30V, V_{DS} = 0		−20	−100	nA
Feedback Capacitance	C_{rss}	V_{DS} = 20V, V_{GS} = 0, f = 1 MHz		3.0	5.0	pA
Input Capacitance	C_{iss}	V_{DG} = 15V, V_{GS} = 0, f = 1 MHz		15	20	pF
Noise Voltage	$\bar{e}_n$	V_{DG} = 15V, I_D = 0.2 mA, f = 10 Hz		8.0	20	nV/$\sqrt{Hz}$
Noise Voltage	$\bar{e}_n$	V_{DG} = 15V, I_D = 0.2 mA, f = 100 Hz		6.0	17	nV/$\sqrt{Hz}$

Parameter Interactions

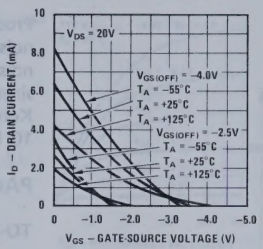


Process 57

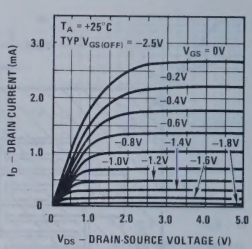
Transfer Characteristics



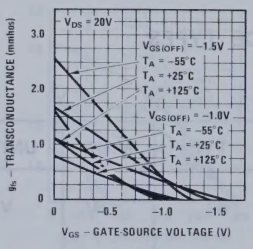
Transfer Characteristics



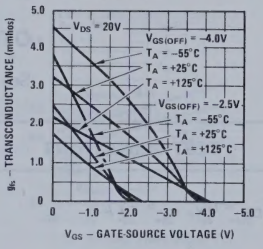
Common Drain-Source Characteristics



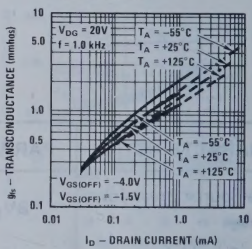
Transconductance Characteristics



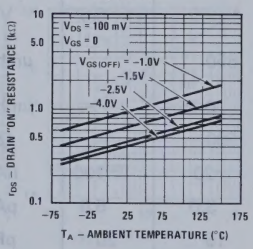
Transconductance Characteristics



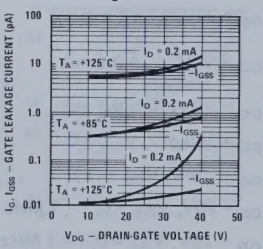
Transconductance vs Drain Current



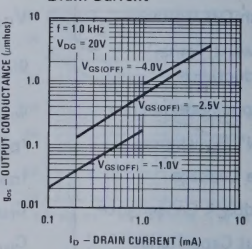
Channel Resistance vs Temperature



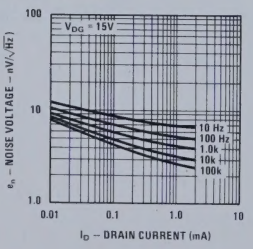
Leakage Current vs Voltage



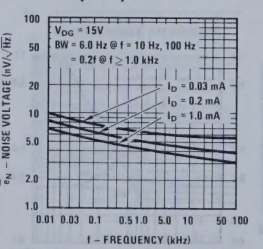
Output Conductance vs Drain Current



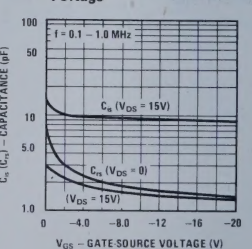
Noise Voltage vs Current



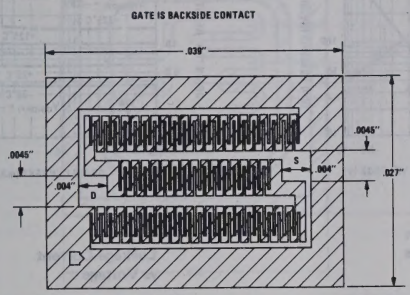
Noise Voltage vs Frequency



Capacitance vs Voltage



Process 58 N-Channel Junction FET



DESCRIPTION

Process 58 was developed for analog or digital switching applications where very low $r_{DS(ON)}$ is mandatory. Switching times are very fast and $R_{DS(ON)}$ C_{iss} time constant is low. The 6Ω typical on resistance is very useful in precision multiplex systems where switch resistance must be held to an absolute minimum. With r_{DS} increasing only 0.7%/ °C, accuracy is retained over a wide temperature excursion.

PACKAGES:

TO-52

PRINCIPAL DEVICE TYPES:

2N5432, 33, 34
NF 580 SERIES

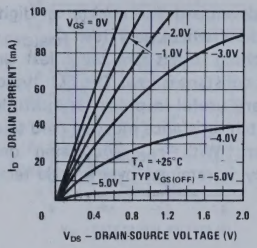
OTHER DEVICE TYPES

See pages 41 and 48.

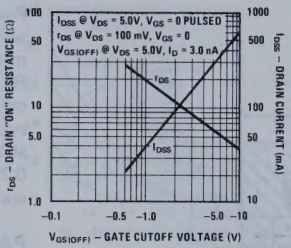
CHARACTERISTIC	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Gate-Source Breakdown Voltage	BV_{GSS}	V_{DS} = 0V, I_G = −1 μA	−25	−30	−50	V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = 5V, V_{GS} = 0 Pulse Test	100	400	1000	mA
Reverse Gate Leakage	I_{GSS}	V_{GS} = −15V, V_{DS} = 0		−50	−500	pA
"ON" Resistance	r_{DS}	V_{DS} = 100 mV, V_{GS} = 0	3.0	6.0	20	Ω
Pinch Off Voltage	$V_{GS(OFF)}$	V_{DS} = 5V, I_D = 3 nA	−0.5	−5.0	−12	V
Drain "OFF" Current	$I_{D(OFF)}$	V_{DS} = 5V, V_{GS} = −10V		0.05	20	nA
Feedback Capacitance	C_{rss}	V_{DG} = 15V, I_D = 2 mA, f = 1 MHz		12	25	pF
Input Capacitance	C_{iss}	V_{DG} = 15V, I_D = 2 mA, f = 1 MHz		25	50	pF
Forward Transconductance	g_{fs}	V_{DG} = 10V, I_D = 2 mA		10		mmhos
Output Conductance	g_{os}	V_{DG} = 10V, I_D = 2 mA		100		μmhos
Noise Voltage	$\bar{e}n$	V_{DG} = 15V, I_D = 2 mA, f = 100 Hz		6.0		$nV/\sqrt{Hz}$

Process 58

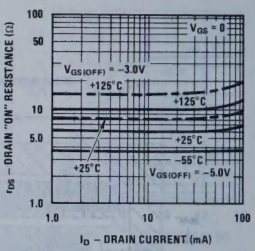
Common Drain-Source Characteristics



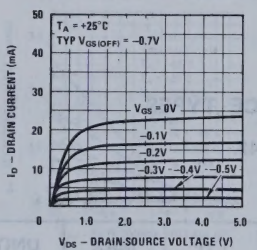
Parameter Interactions


I_{DSS} @ V_{DS} = 5.0V, V_{GS} = 0 PULSED
r_{DS} @ V_{DS} = 100 mV, V_{GS} = 0
$V_{GS(OFF)}$ @ V_{DS} = 5.0V, I_D = 3.0 nA
r_{DS}
I_{DSS}
r_{DS} – DRAIN "ON" RESISTANCE (Ω)
I_{DSS} – DRAIN CURRENT (mA)
$V_{GS(OFF)}$ – GATE CUTOFF VOLTAGE (V)

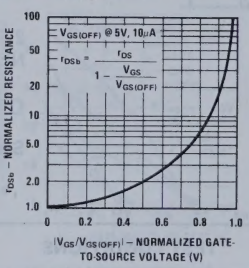
"ON" Resistance vs Drain Current



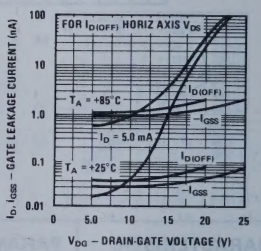
Common Drain-Source Characteristics



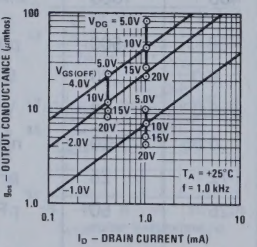
Normalized Drain Resistance vs Bias Voltage


$V_{GS(OFF)}$ @ 5V, 10μA
$r_{DSb} = \frac{r_{DS}}{1 - \frac{V_{GS}}{V_{GS(OFF)}}}$
r_{DSb} – NORMALIZED RESISTANCE
$|V_{GS}/V_{GS(OFF)}|$ – NORMALIZED GATE-TO-SOURCE VOLTAGE (V)

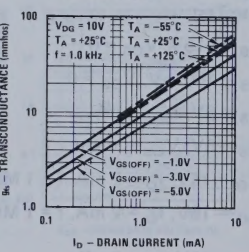
Leakage Current vs Voltage



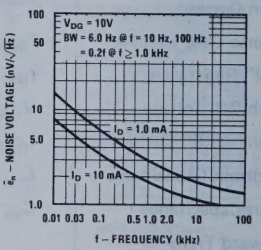
Output Conductance vs Drain Current



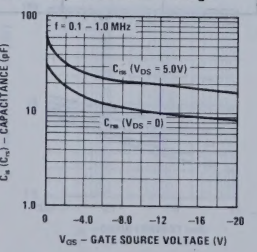
Transconductance vs Drain Current



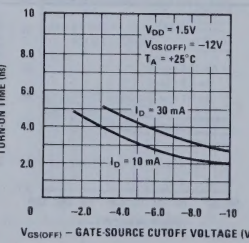
Noise Voltage vs Frequency



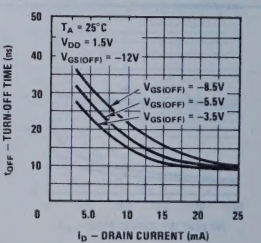
Capacitance vs Voltage



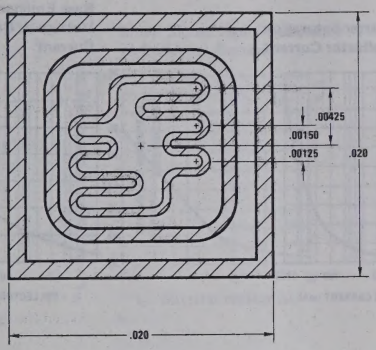
Switching Turn-On vs Gate-Source Voltage



Switching Turn-On Time vs Drain Current



Process 60 PNP Medium Power



DESCRIPTION

Complements Process 09.

APPLICATION

These devices are designed for general purpose amplifier applications at collector currents to 500 mA.

PRINCIPAL DEVICE TYPES:

TO-105 CS9012

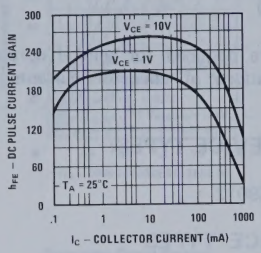
OTHER DEVICE TYPES

See page 42.

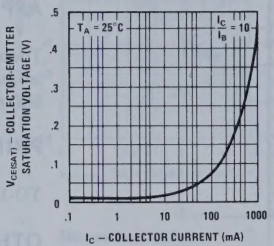
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
C_{OB}	V_{CB} = 10V		8	12	pF	
C_{IB}	V_{EB} = 1V		22	26	pF	
NF	V_{CE} = 10V, I_C = 1 mA R_S = 1k, f = 1 kHz		0.5		dB	
f_T	V_{CE} = 10V, I_C = 100 mA		400		MHz	
h_{FE}	V_{CE} = 1V, I_C = 1 mA	50	200	300		
h_{FE}	V_{CE} = 1V, I_C = 50 mA	50	190	300		
h_{FE}	V_{CE} = 1V, I_C = 150 mA	50	165	300		
h_{FE}	V_{CE} = 1V, I_C = 500 mA	30	80	200		
$V_{CE(SAT)}$	I_C = 150 mA, I_B = 15 mA		0.1	0.2	V	
$V_{CE(SAT)}$	I_C = 500 mA, I_B = 50 mA		0.3	0.5	V	
$V_{BE(SAT)}$	I_C = 150 mA, I_B = 15 mA		0.8	0.96	V	
$V_{BE(SAT)}$	I_C = 500 mA, I_B = 50 mA		0.98	1.2	V	
I_{CES}	V_{CE} = 20V			100	nA	
I_{CEO}	V_{CE} = 20V			100	nA	
BV_{CBO}	I_C = 100 μA	40	68		V	
BV_{EBO}	I_E = 10 μA	7	8		V	
BV_{CEO}	I_C = 10 mA	25	40		V	

Process 60

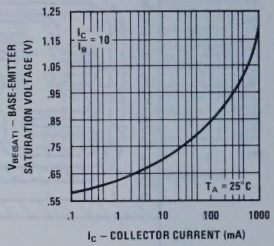
DC Pulse Current Gain vs Collector Current



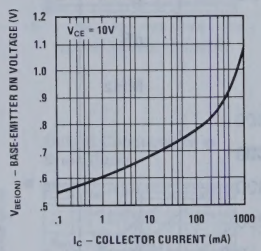
Collector-Emitter Saturation Voltage vs Collector Current



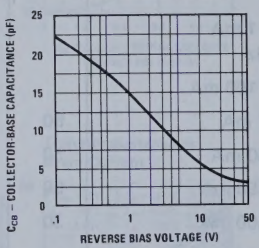
Base-Emitter Saturation Voltage vs Collector Current



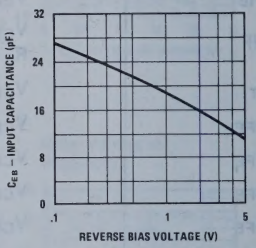
Base-Emitter On Voltage vs Collector Current



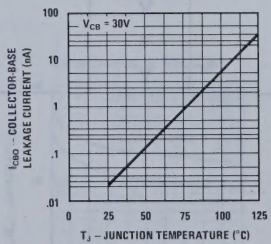
Collector-Base Capacitance vs Reverse Bias Voltage



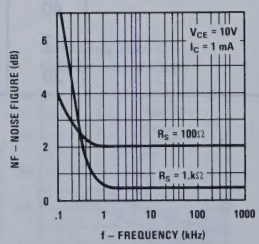
Input Capacitance vs Reverse Bias Voltage



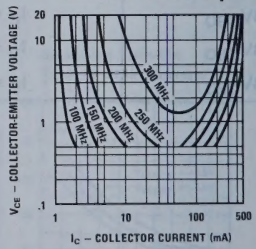
Collector-Base Diode Reverse Current vs Temperature



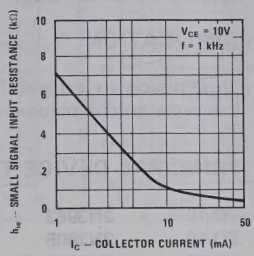
Noise Figure vs Frequency



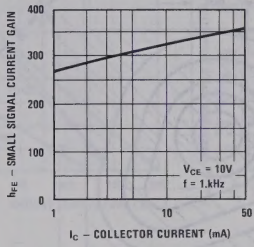
Contours of Constant Gain Bandwidth Product (f_T)



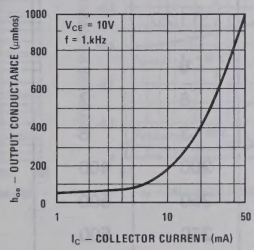
Small Signal Input Resistance vs Collector Current



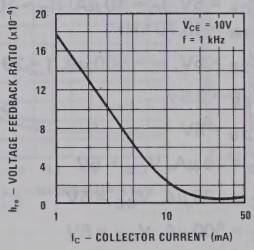
Small Signal Current Gain vs Collector Current



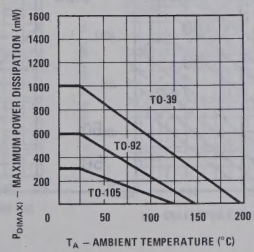
Small Signal Output Conductance vs Collector Current



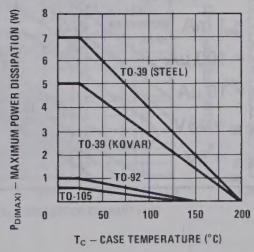
Small Signal Voltage Feedback Ratio vs Collector Current



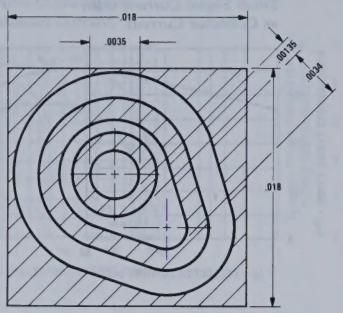
Maximum Power Dissipation vs Ambient Temperature



Maximum Power Dissipation vs Case Temperature



Process 62 PNP Small Signal



DESCRIPTION

Process 62 is a nonoverlay double diffused, silicon epitaxial device. Complement to Process 07.

APPLICATION

These devices are designed for low level, high gain, low noise general purpose amplifier applications.

PRINCIPAL DEVICE TYPES:

TO-18	2N3962
TO-46	2N2605
TO-92	2N5086 (EBC), 2N4058 (ECB)
TO-106	2N4250

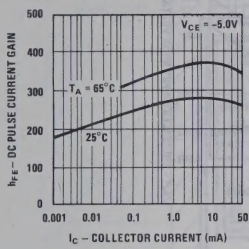
OTHER DEVICE TYPES

See page 32 through 34 and 43 through 45.

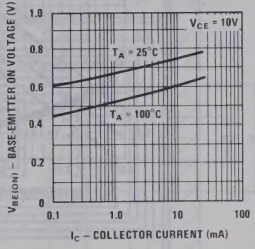
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
NF	V_{CE} = 5V, I_C = 10 μA, R_S = 10 kΩ, P_{BW} = 15.70 kHz		1.20	3	dB	
h_{fe}	V_{CE} = 5V, I_C = 500 μA, f = 20 MHz	5	6			
C_{eb}	V_{EB} = 0.5V		6	7	pF	
C_{cb}	V_{CB} = 5V		3	5	pF	
h_{FE}	I_C = 10 μA, V_{CE} = 5V	50	200	400		
h_{FE}	I_C = 100 μA, V_{CE} = 5V	50	250	500		
h_{FE}	I_C = 500 μA, V_{CE} = 5V	50	260	500		
h_{FE}	I_C = 1 mA, V_{CE} = 5V	50	270	500		
h_{FE}	I_C = 10 mA, V_{CE} = 5V	50	270	500		
$V_{CE(SAT)}$	I_C = 1 mA, I_B = 0.1mA		0.05	0.10	V	
$V_{CE(SAT)}$	I_C = 10 mA, I_B = 1 mA		0.08	0.11	V	
$V_{BE(SAT)}$	I_C = 1 mA, I_B = 0.1 mA		0.60	0.70	V	
$V_{BE(SAT)}$	I_C = 10 mA, I_B = 1 mA		0.70	0.90	V	
BV_{CEO}	I_C = 1 mA	60	80		V	
BV_{CBO}	I_C = 100 μA	80	90		V	
BV_{EBO}	I_E = 10 μA	6	7.50		V	
I_{CBO}	V_{CB} = 45V			50	nA	
I_{EBO}	V_{EB} = 5V			50	nA	

Process 62

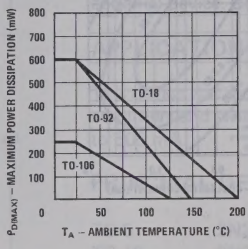
DC Pulse Current Gain vs Collector Current



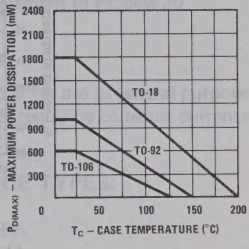
Base-Emitter On Voltage vs Collector Current



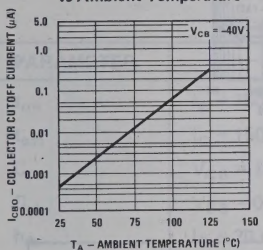
Maximum Power Dissipation vs Ambient Temperature



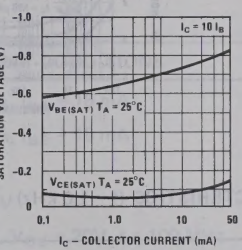
Maximum Power Dissipation vs Case Temperature



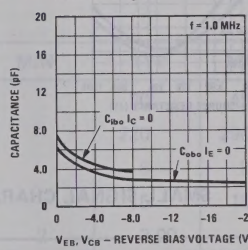
Collector Cutoff Current vs Ambient Temperature



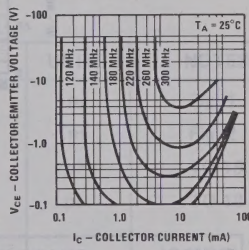
Collector and Base Saturation Voltage vs Collector Current



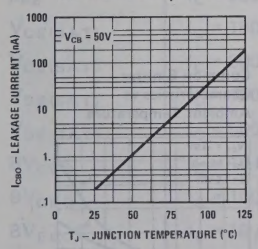
Input and Output Capacitances vs Reverse Bias Voltage



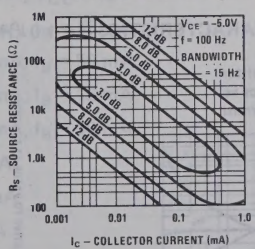
Contours of Constant Gain Bandwidth Product (f_T)



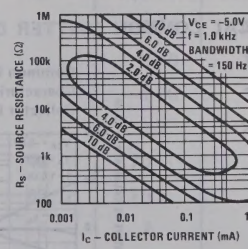
Collector-Base Diode Current vs Temperature



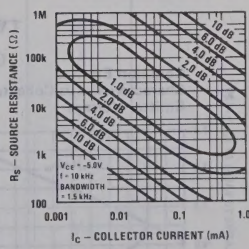
Contours of Constant Narrow Band Noise Figure



Contours of Constant Narrow Band Noise Figure

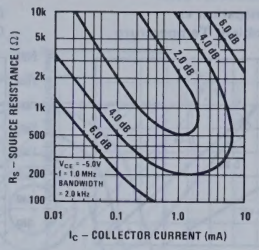


Contours of Constant Narrow Band Noise Figure

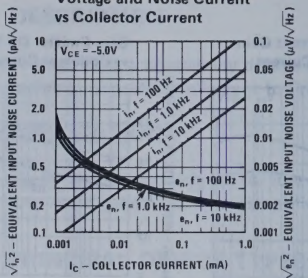


Process 62

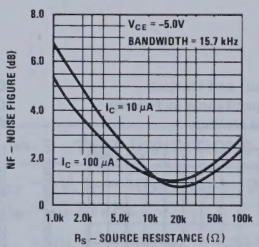
Contours of Constant Narrow Band Noise Figure



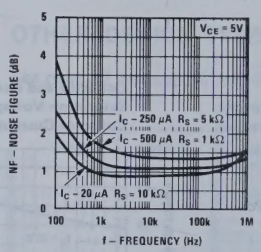
Equivalent Input Noise Voltage and Noise Current vs Collector Current


$\sqrt{i_n^2}$ – EQUIVALENT INPUT NOISE CURRENT (pA/√Hz)
$\sqrt{e_n^2}$ – EQUIVALENT INPUT NOISE VOLTAGE (μV/√Hz)
I_C – COLLECTOR CURRENT (mA)
V_{CE} = -5.0V
i_n, f = 100 Hz
i_n, f = 1.0 kHz
i_n, f = 10 kHz
e_n, f = 100 Hz
e_n, f = 1.0 kHz
e_n, f = 10 kHz

Wide Band Noise Figure vs Source Resistance



Noise Figure vs Frequency

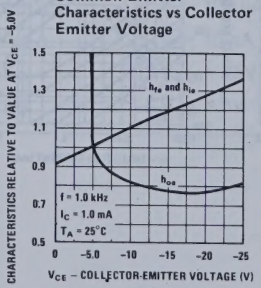


SMALL SIGNAL CHARACTERISTICS (f = 1.0 kHz)

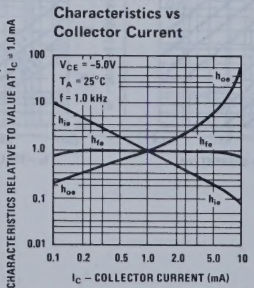
SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
h_{ie}	Input Resistance	2.5	8.0	20	kΩ	I_C = 1.0 mA V_{CE} = -5.0V
h_{oe}	Output Conductance	5.0	19	50	μmho	I_C = 1.0 mA V_{CE} = -5.0V
h_{re}	Voltage Feedback Ratio			10	x10^{-4}	I_C = 1.0 mA V_{CE} = -5.0V
h_{fe}	Small Signal Current Gain	100	250	800		I_C = 1.0 mA V_{CE} = -5.0V

TYPICAL COMMON EMITTER CHARACTERISTICS (f = 1.0 kHz)

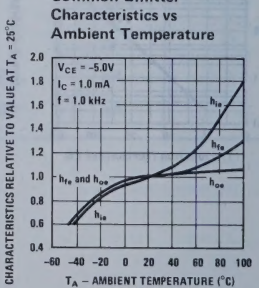
Common Emitter Characteristics vs Collector Emitter Voltage



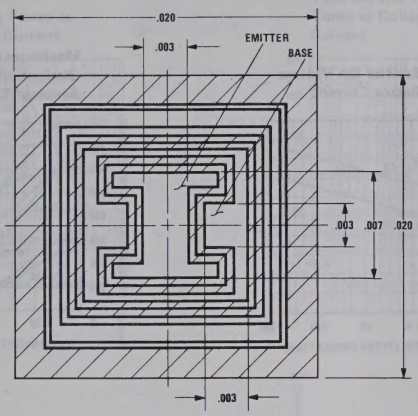
Common Emitter Characteristics vs Collector Current



Common Emitter Characteristics vs Ambient Temperature



Process 63 PNP Medium Power



DESCRIPTION

Process 63 is a nonoverlay double diffused, silicon epitaxial device. Complement to Process 20.

APPLICATION

This device was designed for use as general purpose amplifiers and switches requiring collector currents to 500 mA.

PRINCIPAL DEVICE TYPES:

TO-5	2N2905A
TO-18	2N2907A
TO-92	2N4403 (EBC), 2N3702 (ECB)
TO-105	2N3645
TO-106	2N4143

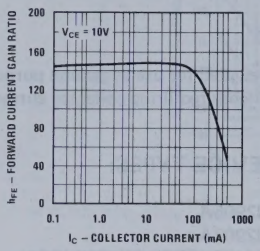
OTHER DEVICE TYPES

See pages 34 through 41.

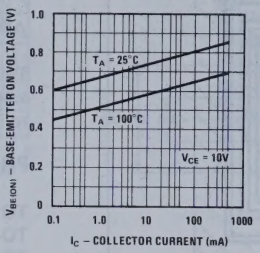
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
t_{on}	I_C = 150 mA, I_{B1} = 15 mA		30	45	ns	Fig. 1
t_{off}	I_C = 150 mA, I_{B2} = 15 mA		220	290	ns	Fig. 2
C_{cb}	V_{CB} = 10V		6	8	pF	TO-18
C_{eb}	V_{EB} = 0.50V		15	18	pF	TO-18
h_{fe}	I_C = 20 mA, V_{CE} = 20V, f = 100 MHz	2	3.00			
NF (spot)	I_C = 100 μA, V_{CE} = 10V, R_S = 1k f = 1 kHz		1.5	3	dB	
h_{FE}	I_C = 1 mA, V_{CE} = 10V	50	140	400		
h_{FE}	I_C = 10 mA, V_{CE} = 10V	50	140	400		
h_{FE}	I_C = 100 mA, V_{CE} = 10V	50	95	400		
h_{FE}	I_C = 150 mA, V_{CE} = 10V	50	80	400		
h_{FE}	I_C = 500 mA, V_{CE} = 10V	40	50	200		
$V_{CE(SAT)}$	I_C = 150 mA, I_B = 15 mA		0.25	0.40	V	
$V_{CE(SAT)}$	I_C = 500 mA, I_B = 50 mA		0.40	1.00	V	
$V_{BE(SAT)}$	I_C = 150 mA, I_B = 15 mA		1.00	1.3	V	
$V_{BE(SAT)}$	I_C = 500 mA, I_B = 50 mA		1.2	2.0	V	
BV_{CEO}	I_C = 10 mA	40	70		V	
BV_{CBO}	I_C = 100 μA	60	70		V	
BV_{EBO}	I_E = 10 μA	5	7		V	
I_{CBO}	V_{CB} = 40V			50	nA	
I_{EBO}	V_{EB} = 3V			50	nA	

Process 63

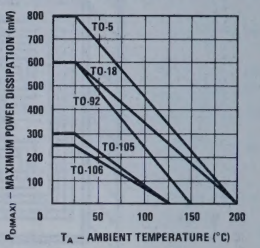
DC Pulse Current Gain vs Collector Current



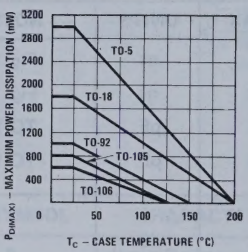
Base-Emitter On Voltage vs Collector Current



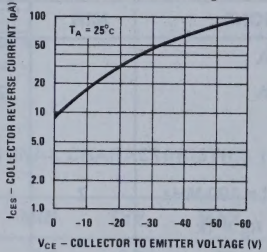
Maximum Power Dissipation vs Ambient Temperature



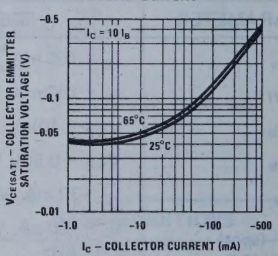
Maximum Power Dissipation vs Case Temperature



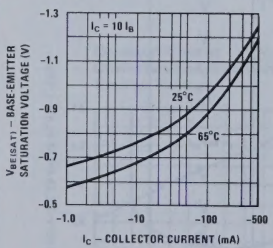
Collector Reverse Current vs Reverse Bias Voltage



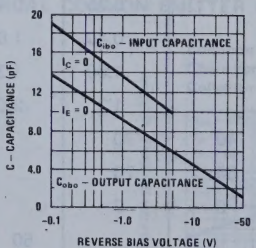
Pulsed Collector Saturation Voltage vs Collector Current



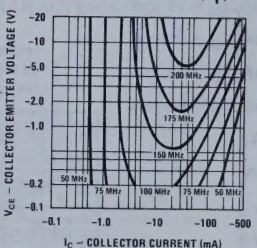
Pulsed Base Saturation Voltage vs Collector Current



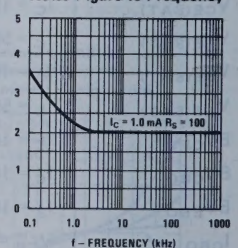
Input and Output Capacitances vs Reverse Bias Voltage



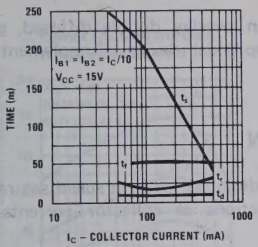
Contours of Constant Gain Bandwidth Product (f_T)



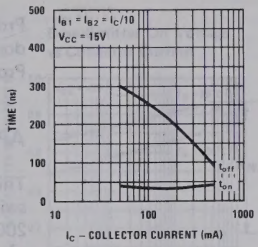
Noise Figure vs Frequency



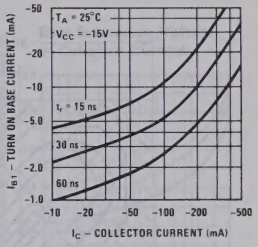
Switching Times vs Collector Current



Turn On and Turn Off Times vs Collector Current



Rise Time vs Collector and Turn On Base Currents



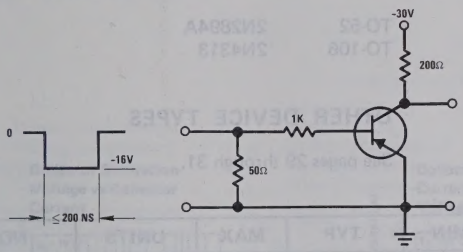


FIGURE 1. Saturated Turn-On Switching Time Test Circuit

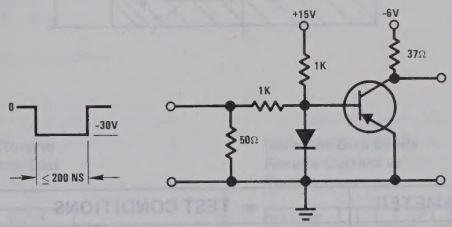
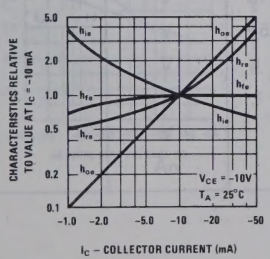


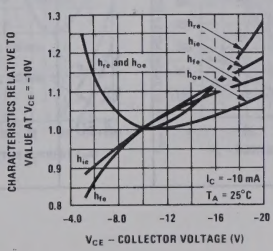
FIGURE 2. Saturated Turn-Off Switching Time Test Circuit

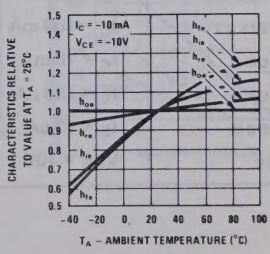
SMALL SIGNAL CHARACTERISTICS (f = 1.0 kHz)

SYMBOL	CHARACTERISTIC	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
h_{ie}	Input Resistance		480	2000	ohms	I_C = 10 mA	V_{CE} = –10V
h_{oe}	Output Conductance		80	1200	μmhos	I_C = 10 mA	V_{CE} = –10V
h_{re}	Voltage Feedback Ratio		162	1500	$x10^{-6}$	I_C = 10 mA	V_{CE} = –10V
h_{fe}	Small Signal Current Gain	100				I_C = 10 mA	V_{CE} = –10V

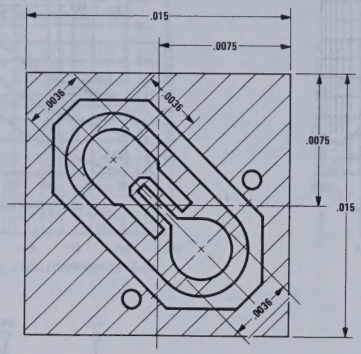
TYPICAL COMMON EMITTER CHARACTERISTICS (f = 1.0 kHz)







Process 64 PNP High Speed Switch



DESCRIPTION

Process 64 is an overlay double diffused, gold doped silicon epitaxial device. Complement to Process 22.

APPLICATION

This device was designed for high speed saturated switching applications at collector currents to 200 mA.

PRINCIPAL DEVICE TYPES:

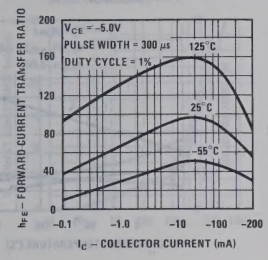
TO-52	2N2894A
TO-106	2N4313

OTHER DEVICE TYPES

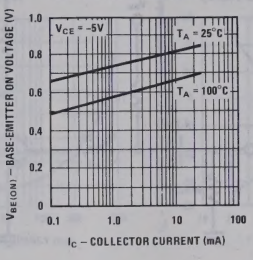
See pages 29 through 31.

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
t_{on}	I_C = 30 mA, I_{B1} = 3 mA		10	20	ns	Fig. 1
t_{off}	I_C = 30 mA, I_{B2} = 3 mA		15	25	ns	Fig. 1
t_s	$I_C = I_{B1} = I_{B2}$ = 10 mA		15	20	ns	
C_{ob}	V_{CE} = 5V		3.0	4.5	pF	TO-18
C_{ib}	V_{EB} = 0.5V		5.0	6.0	pF	TO-18
h_{fe}	f = 100 MHz, I_C = 30 mA, V_{CE} = 10V	8	12			
h_{FE}	I_C = 1 mA	20	65			
h_{FE}	I_C = 10 mA	30	95			
h_{FE}	I_C = 30 mA	40	95			
h_{FE}	I_C = 100 mA	30	85			
$V_{CE(SAT)}$	I_C = 10 mA		0.07	0.13	V	
$V_{CE(SAT)}$	I_C = 30 mA		0.11	0.19	V	
$V_{CE(SAT)}$	I_C = 100 mA		0.28	0.45	V	
$V_{BE(SAT)}$	I_C = 10 mA		0.80	0.92	V	
$V_{BE(SAT)}$	I_C = 30 mA		0.90	1.15	V	
$V_{BE(SAT)}$	I_C = 100 mA		1.10	1.50	V	
BV_{CEO}	I_C = 10 mA	12			V	
BV_{CBO}	I_C = 100 μA	12			V	
BV_{EBO}	I_E = 10 μA	4.50			V	
I_{CES}	V_{CE} = 10V			50	nA	

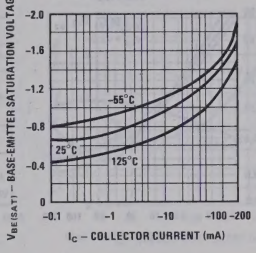
Pulsed DC Current Gain vs Collector Current



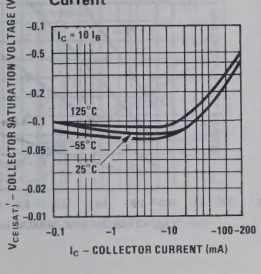
Base-Emitter On Voltage vs Collector Current



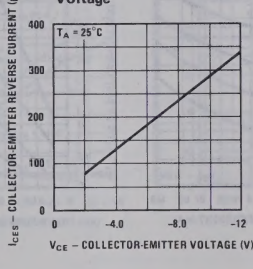
Base Saturation Voltage vs Collector Current



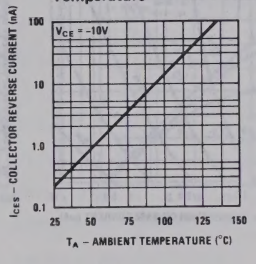
Collector Saturation Voltage vs Collector Current



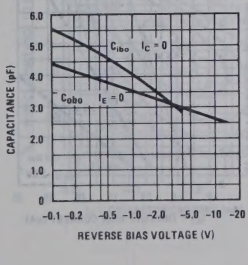
Collector-Base Reverse Current vs Reverse Bias Voltage



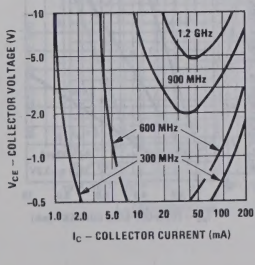
Collector-Base Diode Reverse Current vs Temperature



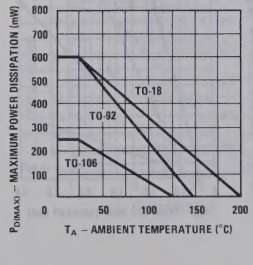
Input and Output Capacitance vs Reverse Bias Voltage



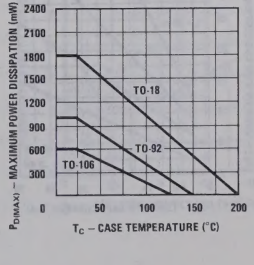
Contours of Constant Gain Bandwidth Product (f_T)



Maximum Power Dissipation vs Ambient Temperature



Maximum Power Dissipation vs Case Temperature



Process 64

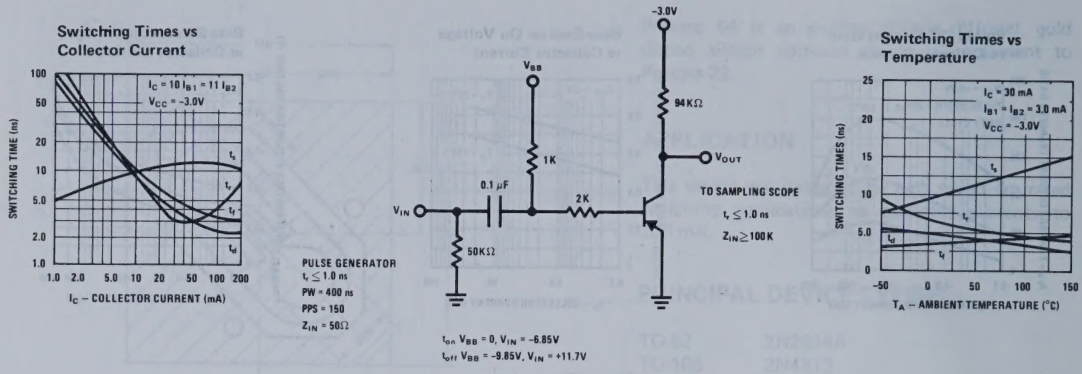
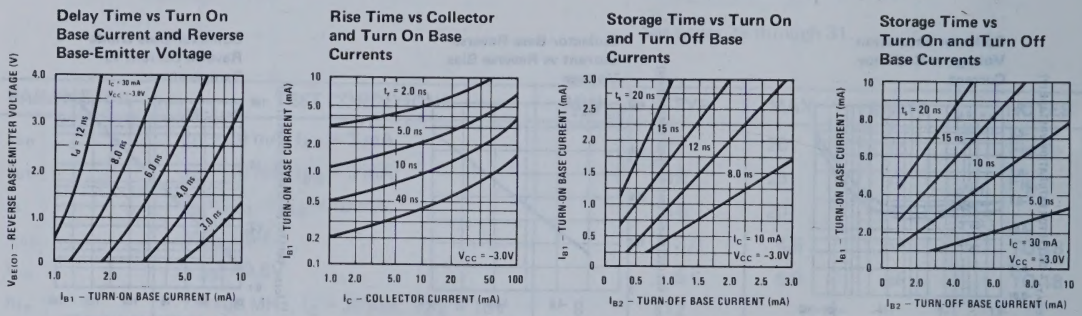
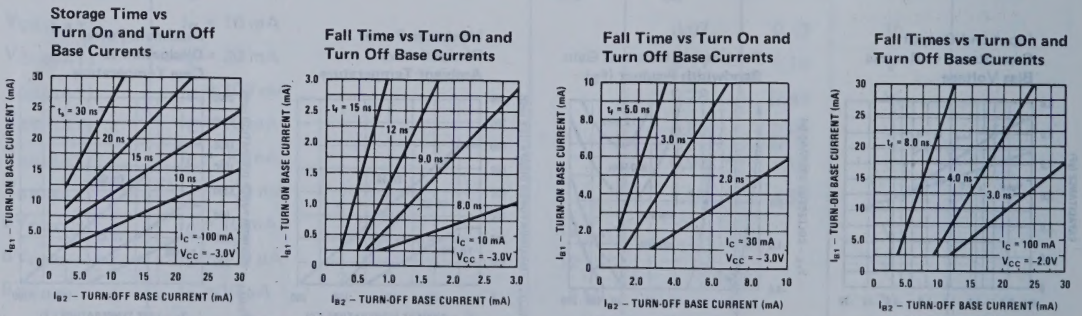


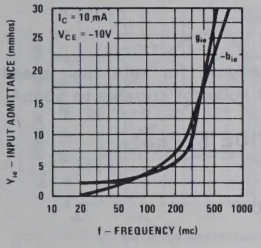
FIGURE 1. Switching Time Test Circuit


Delay Time vs Turn On Base Current and Reverse Base-Emitter Voltage
$V_{BE(O)}$ – REVERSE BASE EMITTER VOLTAGE (V)
t_d = 12 ns
8.0 ns
6.0 ns
4.0 ns
3.0 ns
I_{B1} – TURN-ON BASE CURRENT (mA)
Rise Time vs Collector and Turn On Base Currents
t_r = 2.0 ns
5.0 ns
10 ns
40 ns
$V_{CC} = -3.0V$
I_{B1} – TURN-ON BASE CURRENT (mA)
I_C – COLLECTOR CURRENT (mA)
Storage Time vs Turn On and Turn Off Base Currents
t_s = 20 ns
15 ns
12 ns
8.0 ns
$I_C = 10$ mA
$V_{CC} = -3.0V$
I_{B1} – TURN-ON BASE CURRENT (mA)
I_{B2} – TURN-OFF BASE CURRENT (mA)
Storage Time vs Turn On and Turn Off Base Currents
t_s = 20 ns
15 ns
10 ns
5.0 ns
$I_C = 30$ mA
$V_{CC} = -3.0V$
I_{B1} – TURN-ON BASE CURRENT (mA)
I_{B2} – TURN-OFF BASE CURRENT (mA)

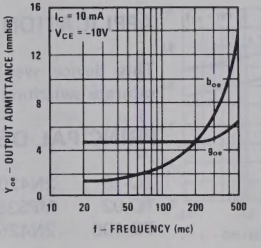

Storage Time vs Turn On and Turn Off Base Currents
t_s = 30 ns
20 ns
15 ns
10 ns
$I_C = 100$ mA
$V_{CC} = -3.0V$
I_{B1} – TURN-ON BASE CURRENT (mA)
I_{B2} – TURN-OFF BASE CURRENT (mA)
Fall Time vs Turn On and Turn Off Base Currents
t_f = 15 ns
12 ns
9.0 ns
8.0 ns
$I_C = 10$ mA
$V_{CC} = -3.0V$
I_{B1} – TURN-ON BASE CURRENT (mA)
I_{B2} – TURN-OFF BASE CURRENT (mA)
Fall Time vs Turn On and Turn Off Base Currents
t_f = 5.0 ns
3.0 ns
2.0 ns
$I_C = 30$ mA
$V_{CC} = -3.0V$
I_{B1} – TURN-ON BASE CURRENT (mA)
I_{B2} – TURN-OFF BASE CURRENT (mA)
Fall Times vs Turn On and Turn Off Base Currents
t_f = 8.0 ns
4.0 ns
3.0 ns
$I_C = 100$ mA
$V_{CC} = -2.0V$
I_{B1} – TURN-ON BASE CURRENT (mA)
I_{B2} – TURN-OFF BASE CURRENT (mA)

COMMON EMITTER VS FREQUENCY Y PARAMETERS

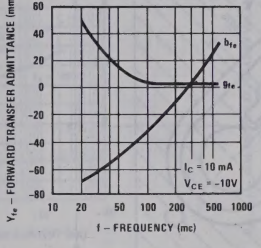
Input Admittance vs Frequency-Output Short Circuit



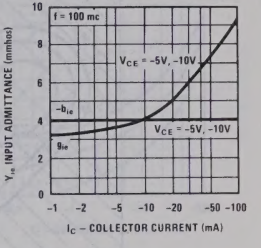
Output Admittance vs Frequency-Input Short Circuit



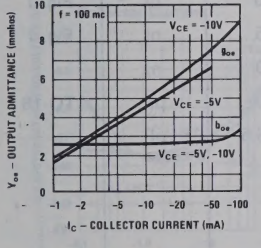
Forward Transfer Admittance vs Frequency-Output Short Circuit



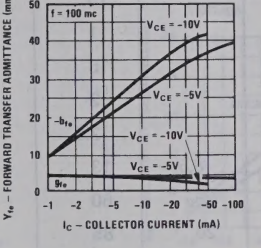
Input Admittance vs Collector Current and Voltage-Output Short Circuit



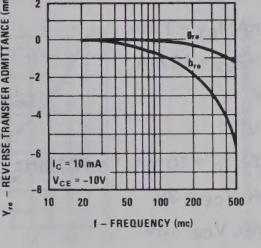
Output Admittance vs Collector Current and Voltage-Input Short Circuit



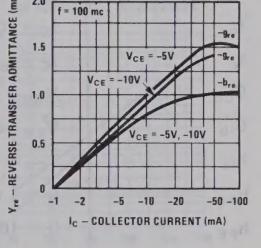
Forward Transfer Admittance vs Collector Current and Voltage-Output Short Circuit



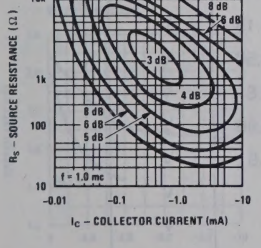
Reverse Transfer Admittance vs Frequency-Input Short Circuit



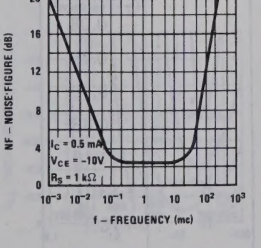
Reverse Transfer Admittance vs Collector Current and Voltage-Input Short Circuit



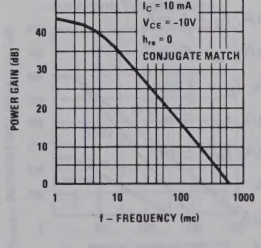
Noise Figure vs Source Resistance and Collector Current



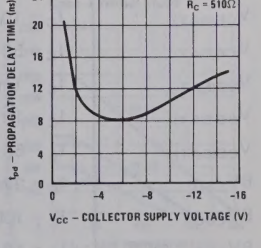
Noise Figure vs Frequency



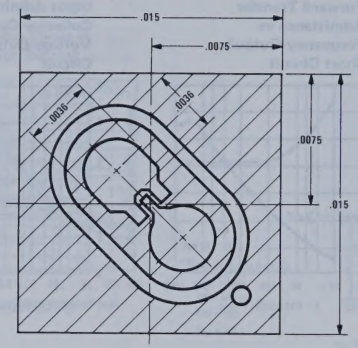
M.A.G. vs Frequency



Propagation Delay Time vs Collector Supply Voltage



Process 65 PNP High Speed Switch



DESCRIPTION

Process 65 is an overlay double diffused, gold doped, silicon epitaxial device.

APPLICATION

This device was designed for very high speed saturate switching at collector currents to 50 mA.

PRINCIPAL DEVICE TYPES:

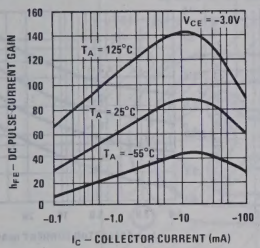
TO-18	2N4208
TO-92	MPS3640
TO-106	2N4258

OTHER DEVICE TYPES

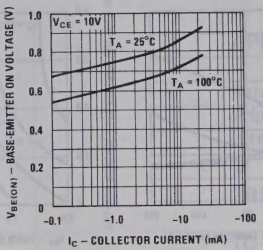
See pages 30 through 32.

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
t_{off}	I_C = 10 mA, I_{B2} = 1 mA		15	20	ns	Fig. 1
t_{on}	I_C = 10 mA, I_{B1} = 1 mA		11	15	ns	Fig. 1
t_s	$I_C = I_{B1} = I_{B2}$ = 10 mA		15	20	ns	
C_{ob}	V_{CB} = 5V		2	3	pF	TO-18
C_{ib}	V_{EB} = .5V		2.5	3.5	pF	
h_{fe}	V_{CE} = 10V, I_C = 10 mA, f = 100 MHz	6.5	13			
h_{FE}	I_C = 1 mA, V_{CE} = 3V	20	60			
h_{FE}	I_C = 10 mA, V_{CE} = 3V	20	85			
h_{FE}	I_C = 50 mA, V_{CE} = 3V	20	75			
h_{FE}	I_C = 100 mA, V_{CE} = 3V	20	60			
h_{FE}	I_C = 1 mA, V_{CE} = .5V	20	60			
h_{FE}	I_C = 10 mA, V_{CE} = .3V	20	67	150		
h_{FE}	I_C = 50 mA, V_{CE} = 1.0V	20	60			
$V_{CE(SAT)}$	I_C = 1 mA, I_B = .1 mA		0.07	0.13	V	
$V_{CE(SAT)}$	I_C = 10 mA, I_B = 1 mA		0.08	0.15	V	
$V_{CE(SAT)}$	I_C = 50 mA, I_B = 5 mA		0.25	0.50	V	
$V_{BE(SAT)}$	I_C = 1 mA, I_B = .1 mA		0.73	0.8	V	
$V_{BE(SAT)}$	I_C = 10 mA, I_B = 1 mA		0.88	0.95	V	
$V_{BE(SAT)}$	I_C = 50 mA, I_B = 5 mA		1.15	1.5	V	
BV_{CEO}	I_C = 3 mA	6	13		V	
BV_{CBO}	I_C = 100 μA	6	13		V	
BV_{EBO}	I_C = 10 μA	4.5			V	
I_{CBO}	V_{CB} = 3V			50	nA	

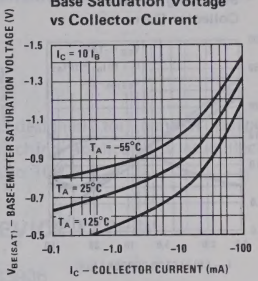
DC Pulse Current Gain vs Collector Current



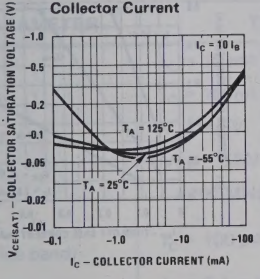
Base-Emitter On Voltage vs Collector Current



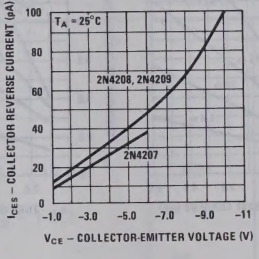
Base Saturation Voltage vs Collector Current



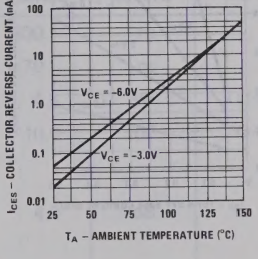
Collector Saturation Voltage vs Collector Current



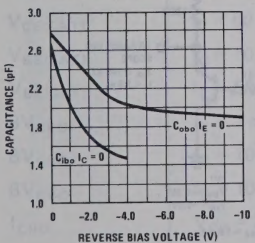
Collector Reverse Current vs Collector-Emitter Voltage



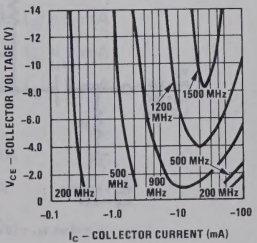
Collector Reverse Current vs Ambient Temperature



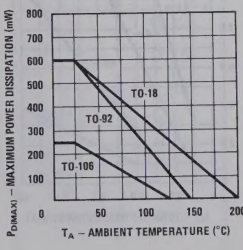
Input and Output Capacitance vs Reverse Bias Voltage



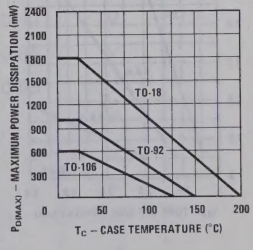
Contours of Constant Gain Bandwidth Product (f_T)



Maximum Power Dissipation vs Ambient Temperature

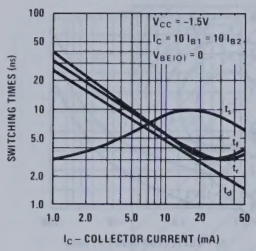


Maximum Power Dissipation vs Case Temperature

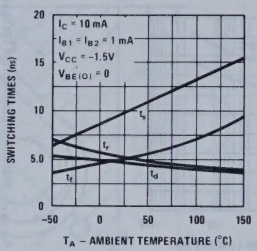


Process 65

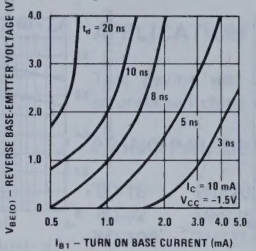
Switching Times vs Collector Current



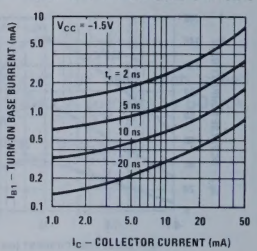
Switching Times vs Ambient Temperature



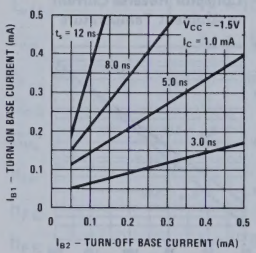
Delay Time vs Turn On Base Current and Reverse Base-Emitter Voltage



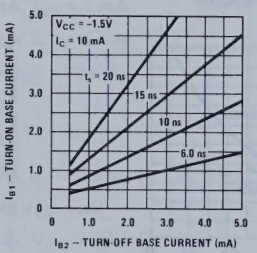
Rise Time vs Collector and Turn On Base Currents



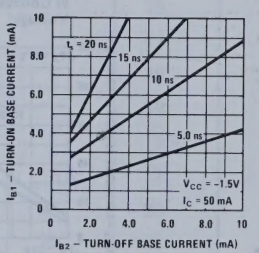
Storage Time vs Turn On and Turn Off Base Currents



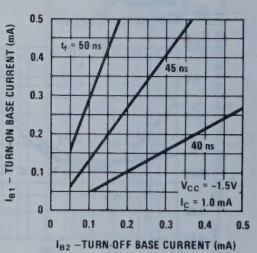
Storage Time vs Turn On and Turn Off Base Currents



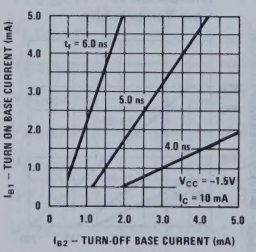
Storage Time vs Turn On and Turn Off Base Currents



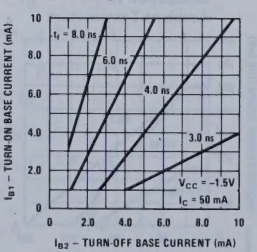
Fall Time vs Turn On and Turn Off Base Currents

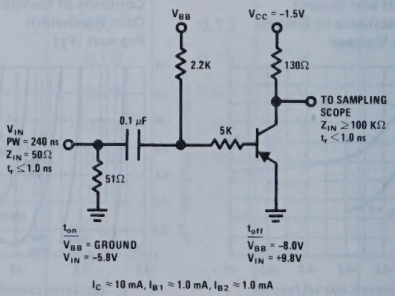


Fall Time vs Turn On and Turn Off Base Currents



Fall Time vs Turn On and Turn Off Base Currents

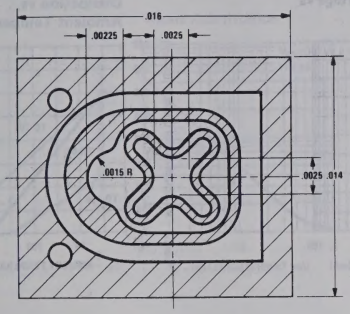




$I_C \approx 10$ mA, $I_{B1} \approx 1.0$ mA, $I_{B2} \approx 1.0$ mA

FIGURE 1. t_{on} and t_{off} Test Circuit

Process 66 PNP Small Signal



DESCRIPTION

Process 66 is a nonoverlay double diffused, gold doped, silicon epitaxial device. Complement to Process 23.

APPLICATION

This device was designed for general purpose amplifier and switching applications at collector currents of 10 μA to 100 mA.

PRINCIPAL DEVICE TYPES:

TO-18	NS3906
TO-92	2N3906
TO-106	SM3906

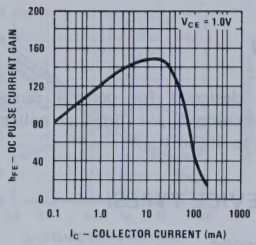
OTHER DEVICE TYPES

See pages 38 through 41.

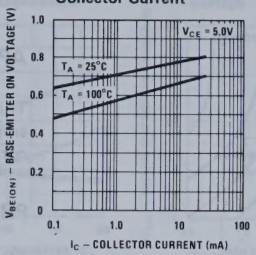
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
t_{off}	I_C = 10 mA, I_{B2} = 1 mA		125	300	ns	
t_{on}	I_C = 10 mA, I_{B1} = 1 mA		30	70	ns	
C_{ob}	V_{CB} = 5V		3.0	4.5	pF	TO-92
C_{ib}	V_{EB} = 0.5V		6.0	10.0	pF	TO-92
h_{fe}	f = 100 MHz, V_{CE} = 20V, I_C = 10 mA	2.5	6.0			
NF (wide band)	I_C = 100 μA, V_{CE} = 5V, R_S = 1 kΩ		2.0	4.0	dB	
h_{FE}	I_C = 0.1 mA, V_{CE} = 1V	40	80			
h_{FE}	I_C = 1 mA, V_{CE} = 1V	40	120			
h_{FE}	I_C = 10 mA, V_{CE} = 1V	40	150	500		
h_{FE}	I_C = 50 mA, V_{CE} = 1V	40	110			
h_{FE}	I_C = 100 mA, V_{CE} = 1V	20	40			
$V_{CE(SAT)}$	I_C = 10 mA, I_B = 1 mA		0.05	0.25	V	
$V_{CE(SAT)}$	I_C = 50 mA, I_B = 5 mA		0.12	0.40	V	
$V_{BE(SAT)}$	I_C = 10 mA, I_B = 1 mA		0.75	0.85	V	
$V_{BE(SAT)}$	I_C = 50 mA, I_B = 5 mA		0.85	0.95	V	
BV_{CEO}	I_C = 1 mA	40	50		V	
BV_{CBO}	I_C = 100 μA	40	60		V	
BV_{EBO}	I_C = 10 μA	5.0			V	
I_{CBO}	V_{CB} = 25V			50	nA	
I_{EBO}	V_{EB} = 4V			50	nA	

Process 66

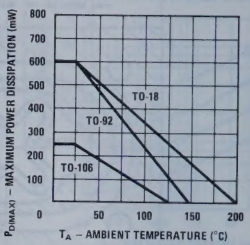
DC Pulse Current Gain vs Collector Current



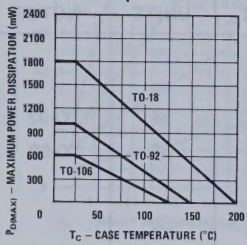
Base-Emitter On Voltage vs Collector Current



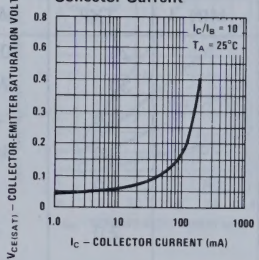
Maximum Power Dissipation vs Ambient Temperature



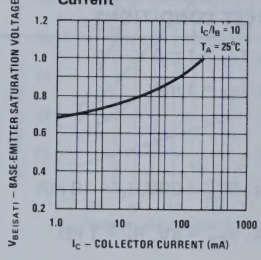
Maximum Power Dissipation vs Case Temperature



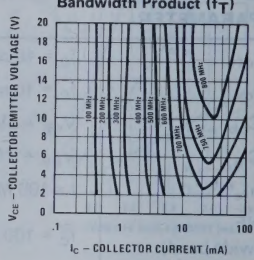
Collector-Emitter Saturation Voltage vs Collector Current



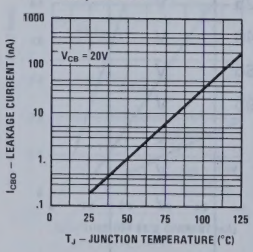
Base-Emitter Saturation Voltage vs Collector Current



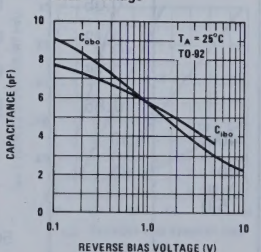
Contours of Constant Gain Bandwidth Product (f_T)



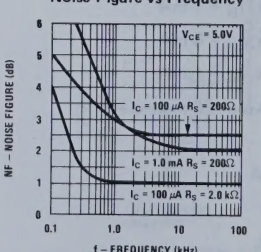
Collector-Base Diode Reverse Current vs Temperature



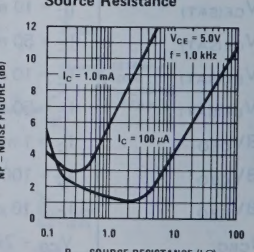
Common Base Open Circuit Input and Output Capacitance vs Reverse Bias Voltage



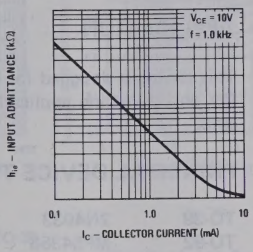
Noise Figure vs Frequency



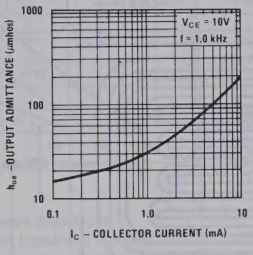
Noise Figure vs Source Resistance



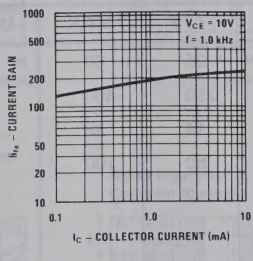
Input Admittance



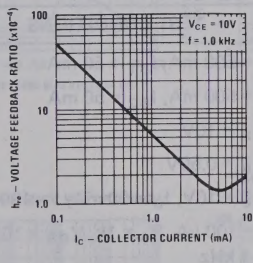
Output Admittance



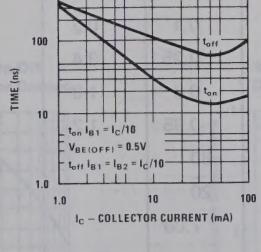
Current Gain



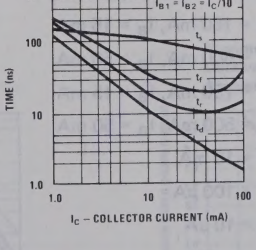
Voltage Feedback Ratio



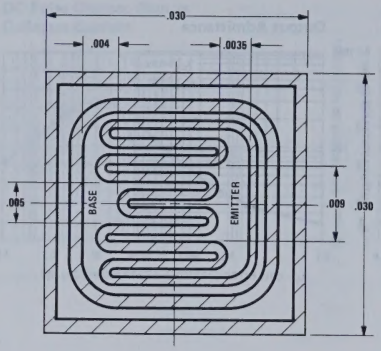
Turn On and Turn Off Times vs Collector Current



Switching Times vs Collector Current



Process 67 PNP Medium Power



DESCRIPTION

Process 67 is a nonoverlay double diffused silicon device. Complement to Process 12.

APPLICATION

This device is designed for general purpose amplifier and switching applications at currents to one amp.

PRINCIPAL DEVICE TYPES:

TO-39	2N4033
TO-92	MPS4356
TO-106	2N4356

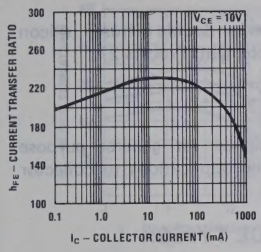
OTHER DEVICE TYPES

See pages 42, 43, 46 and 47.

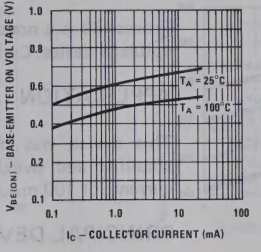
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
t_{on}	I_C = 500 mA, I_{B1} = 50 mA	20	25	60	ns	
t_{off}	I_C = 500 mA, I_{B2} = 50 mA	200	250	400	ns	
C_{ob}	V_{CB} = 10V		14	18	pF	TO-39
C_{ib}	V_{EB} = 0.50V		80	100	pF	TO-39
h_{fe}	V_{CE} = 10V, I_C = 50 mA, f = 100 MHz	1.5	2			
NF (spot)	I_C = 100 μA, R_S = 1k, V_{CE} = 10V, f = 1 kHz		0.5	4	dB	
h_{FE}	I_C = 0.10 mA	50	200			
h_{FE}	I_C = 1.0 mA	50	220			
h_{FE}	I_C = 10 mA	50	230	350		
h_{FE}	I_C = 100 mA	50	220			
h_{FE}	I_C = 500 mA	50	170			
h_{FE}	I_C = 1A	25	150			
$V_{CE(SAT)}$	I_C = 150 mA, I_B = 15 mA		0.1	0.2	V	
$V_{CE(SAT)}$	I_C = 500 mA, I_B = 50 mA		0.25	0.4	V	
$V_{BE(SAT)}$	I_C = 150 mA, I_B = 15 mA		0.8	1.0	V	
$V_{BE(SAT)}$	I_C = 500 mA, I_B = 50 mA		0.95	1.2	V	
BV_{CEO}	I_C = 10 mA	60	80		V	
BV_{CBO}	I_C = 100 μA	80	120		V	
BV_{EBO}	I_E = 10 μA	5.0	7.00		V	
I_{CBO}	V_{CB} = 60V			50	nA	
I_{EBO}	V_{EB} = 4V			50	nA	

Process 67

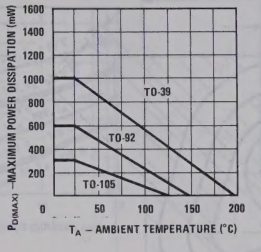
DC Pulse Current Gain vs Collector Current



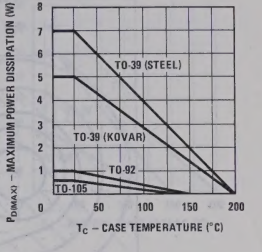
Base-Emitter On Voltage vs Collector Current



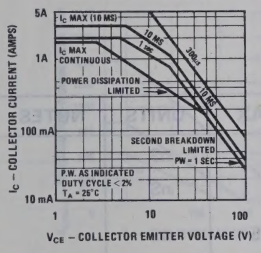
Maximum Power Dissipation vs Ambient Temperature



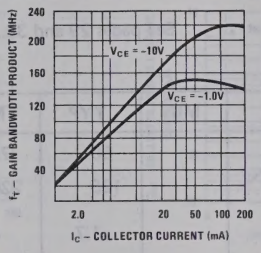
Maximum Power Dissipation vs Case Temperature



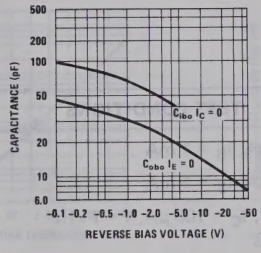
Safe Operating Area TO-39 With "Wake Field" Type 296-4 Heat Sink



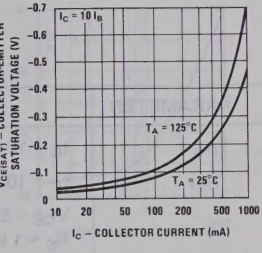
Gain Bandwidth Product vs Collector Current



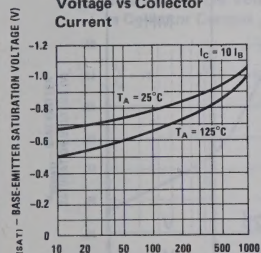
Common Base Open Circuit Input and Output Capacitance vs Reverse Bias Voltage



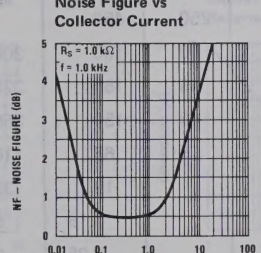
Collector-Emitter Saturation Voltage vs Collector Current



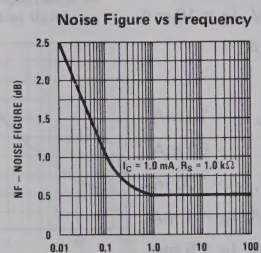
Base-Emittter Saturation Voltage vs Collector Current



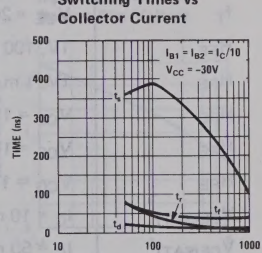
Noise Figure vs Collector Current



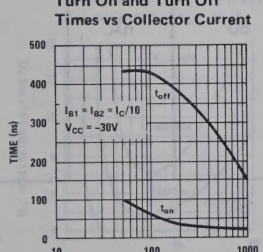
Noise Figure vs Frequency



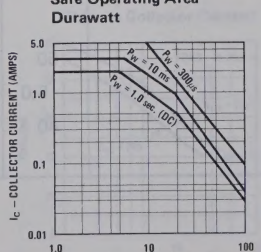
Switching Times vs Collector Current



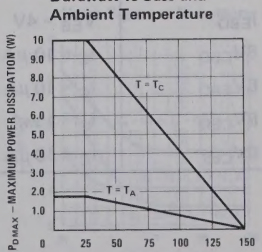
Turn On and Turn Off Times vs Collector Current



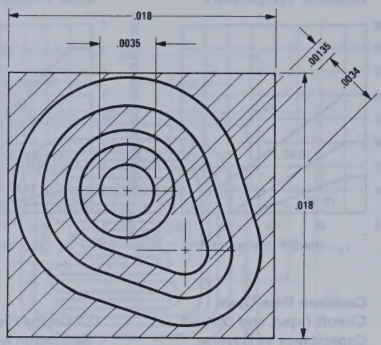
Safe Operating Area Durawatt



Maximum Power Dissipation Durawatt vs Case and Ambient Temperature



Process 69 PNP Small Signal



DESCRIPTION

Process 69 is a nonoverlay double diffused, silicon epitaxial device. Complements Process 27.

APPLICATION

This device was designed for general purpose amplifier and switching applications to collector currents of 100 mA.

PRINCIPAL DEVICE TYPES:

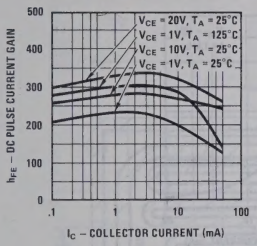
TO-18 2N3251A

OTHER DEVICE TYPES

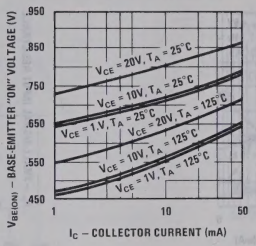
See pages 29 and 30.

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
T_{ON}	I_C = 10 mA, I_B = 1 mA		50	70	nS	
T_{OFF}	I_C = 10 mA, I_B = 1 mA		125	225	nS	
NF	V_{CE} = 5V, I_C = 100 μA, f = 1 kHz R_S = 1 kΩ		1.7	4.5	dB	
C_{OB}	V_{CE} = 5V		4	5.0	pF	
C_{IB}	V_{EB} = 1V		6.5	8.0	pF	
f_T	V_{CE} = 20V, I_C = 10 mA	250	450		MHz	
H_{FE}	1V, 100 μA	40	150	300		
H_{FE}	1V, 1 mA	45	160	325		
H_{FE}	V_{CE} = 1V, I_C = 10 mA	50	150	350		
H_{FE}	V_{CE} = 1V, I_C = 50 mA	15	65	110		
H_{FE}	V_{CG} = 1V, I_C = 100 mA		18	35		
$V_{CE(SAT)}$	I_C = 10 mA, I_B = 1 mA		0.15	0.25	V	
$V_{CE(SAT)}$	I_C = 50 mA, I_B = 5 mA		0.25	0.50	V	
$V_{BE(SAT)}$	I_C = 10 mA, I_B = 1 mA		0.74	0.90	V	
$V_{BE(SAT)}$	I_C = 50 mA, I_B = 5 mA		0.85	1.20	V	
I_{CBO}	V_{CB} = 30V		1.5	50	nA	
I_{EBO}	V_{EB} = 4V		0.05	50	nA	
BV_{CBO}	I_C = 10 μA	50	90			
BV_{EBO}	I_C = 10 μA	5.0	7.0			
BV_{CEO}	I_C = 1 mA	40	70			
BV_{CES}	I_C = 10 μA		90			

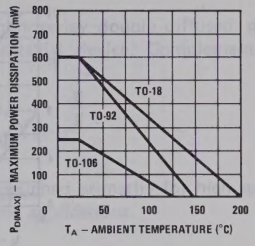
DC Pulse Current Gain vs Collector Current



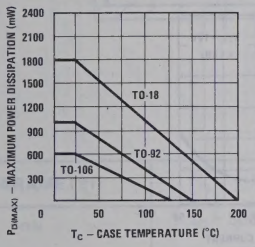
Base-Emitter On Voltage vs Collector Current


V_{CE} = 20V, T_A = 25°C
V_{CE} = 10V, T_A = 25°C
V_{CE} = 1V, T_A = 25°C
V_{CE} = 20V, T_A = 125°C
V_{CE} = 10V, T_A = 125°C
V_{CE} = 1V, T_A = 125°C
$V_{BE(ON)}$ – BASE-EMITTER "ON" VOLTAGE (V)
I_C – COLLECTOR CURRENT (mA)

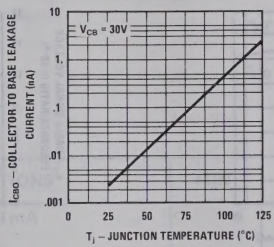
Maximum Power Dissipation vs Ambient Temperature



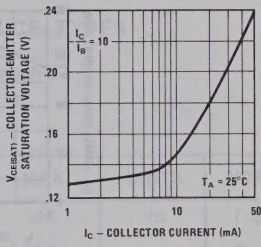
Maximum Power Dissipation vs Case Temperature



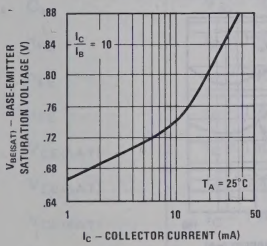
Collector-Base Diode Reverse Current vs Temperature



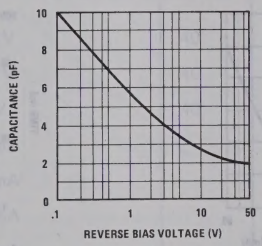
Collector-Emitter Saturation Voltage vs Collector Current



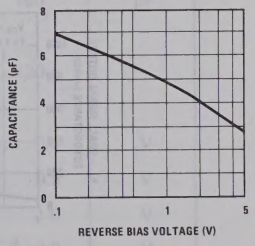
Base-Emitter On Voltage vs Collector Current



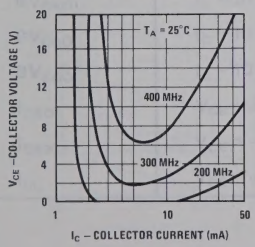
Output Capacitance vs Reverse Bias Voltage



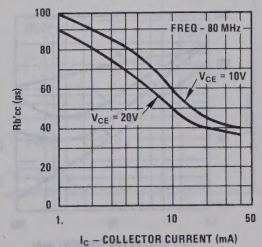
Input Capacitance vs Reverse Bias Voltage



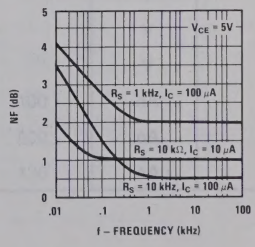
Contours of Constant Gain Bandwidth Product (f_T)



Rb'cc vs Collector Current

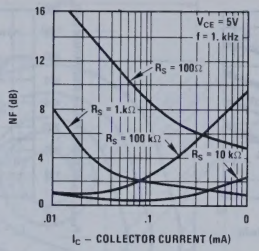


Noise Figure vs Frequency

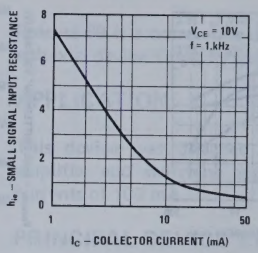


Process 69

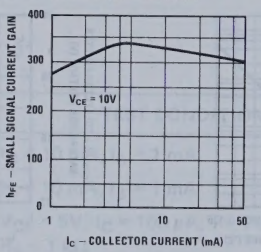
Noise Figure vs Collector Current



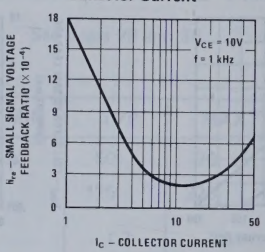
Small Signal Input Resistance vs Collector Current



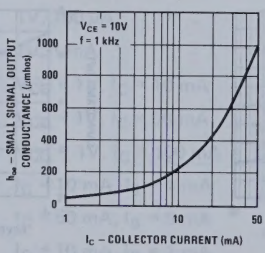
Small Signal Current Gain vs Collector Current



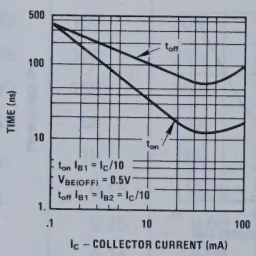
Small Signal Voltage Feedback Ratio vs Collector Current



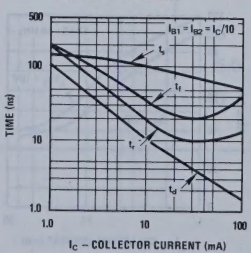
Small Signal Output Conductance vs Collector Current



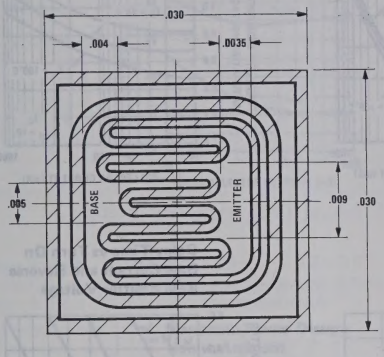
Turn On and Turn Off Times vs Collector Current



Switching Times vs Collector Current



Process 70 PNP Memory Driver



DESCRIPTION

Process 70 is a nonoverlay double diffused, gold doped, silicon epitaxial device. Complement to process 25.

APPLICATION

This device was designed primarily for high speed saturated switching applications.

PRINCIPAL DEVICE TYPES:

TO-39 (pkg. 17) 2N3467

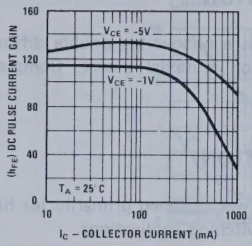
OTHER DEVICE TYPES

See pages 29 through 32.

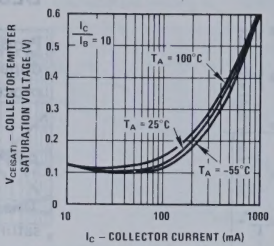
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
t_{ON}	I_C = 500 mA, I_{B1} = 50 mA		20	40	ns	Fig. 1
t_{OFF}	I_C = 500 mA, I_{B2} = 50 mA		64	90	ns	Fig. 2
h_{fe}	I_C = 50 mA, V_{CE} = −10V, f = 100 MHz	1.75	2.9			
C_{ob}	V_{CB} = −10V		14	25	pF	
C_{ib}	V_{eb} = −0.5V		72	100	pF	
h_{FE}	I_C = 150 mA, V_{CE} = −1V	40	120			
h_{FE}	I_C = 500 mA, V_{CE} = −1V	40	75	120		
h_{FE}	I_C = 1 Amp, V_{CE} = −5V	40	85			
$V_{CE(SAT)}$	I_C = 150 mA, I_B = 15 mA		0.165	0.3	V	
$V_{CE(SAT)}$	I_C = 500 mA, I_B = 50 mA		0.30	0.5	V	
$V_{CE(SAT)}$	I_C = 1 Amp, I_B = 100 mA		0.50	1.0	V	
$V_{BE(SAT)}$	I_C = 150 mA, I_B = 15 mA		0.80	1.0	V	
$V_{BE(SAT)}$	I_C = 500 mA, I_B = 50 mA	0.8	0.90	1.2	V	
$V_{BE(SAT)}$	I_C = 1 Amp, I_B = 100 mA		1.1	1.6	V	
BV_{CEO}	I_C = 10 mA	40	66		V	
BV_{CBO}	I_C = 10 μA	40	98		V	
BV_{EBO}	I_E = 10 μA	5	8.0		V	
I_{CBO}	V_{CB} = 30V		10	100	nA	
I_{CEX}	V_{CE} = −30V, $V_{BE(OFF)}$ = −3V		10	100	nA	
I_{bL}	V_{CE} = −30V, $V_{BE(OFF)}$ = −3V		10	120	nA	

Process 70

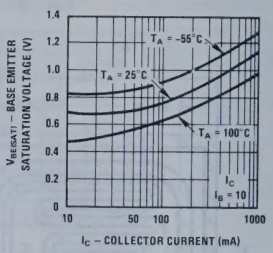
DC Pulse Current Gain vs Collector Current



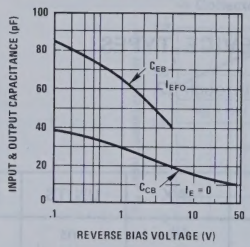
Collector-Emitter Saturation Voltage vs Collector Current



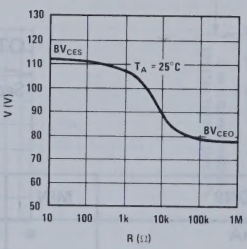
Base-Emitter Saturation Voltage vs Collector Current



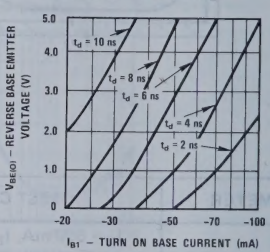
Input & Output Capacitance vs Reverse Bias Voltage



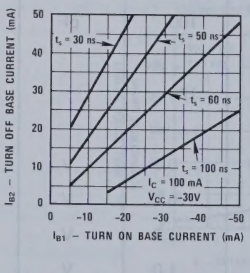
BV_{CER} vs R_{BE} I_C = 10 mA



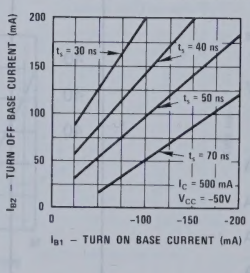
Delay Time vs Turn On Base Current and Reverse Base Emitter Voltage



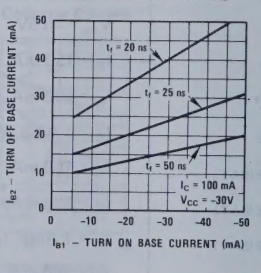
Storage Time vs Turn On and Turn Off Base Currents



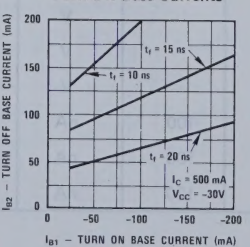
Storage Time vs Turn On and Turn Off Base Currents



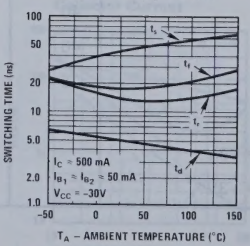
Fall Time vs Turn On and Turn Off Base Currents



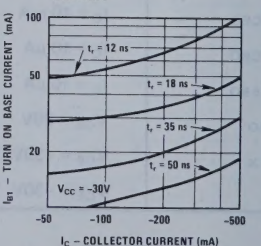
Fall Time vs Turn On and Turn Off Base Currents



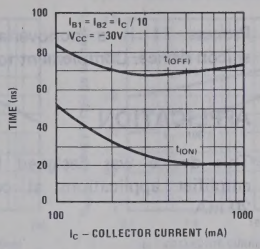
Switching Times vs Ambient Temperature



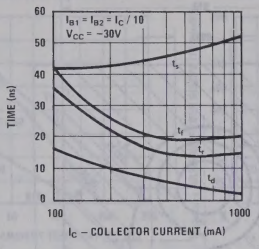
Rise Time vs Collector Current and Turn On Base Current



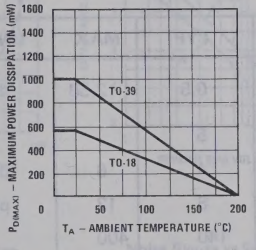
Turn On and Turn Off Times vs Collector Current



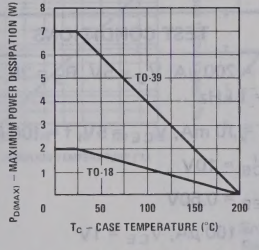
Switching Times vs Collector Current



Maximum Power Dissipation vs Ambient Temperature



Maximum Power Dissipation vs Case Temperature



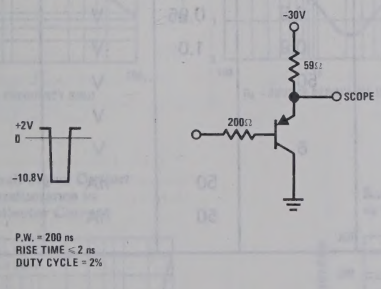


FIGURE 1. t_{on} Equivalent Test Circuit

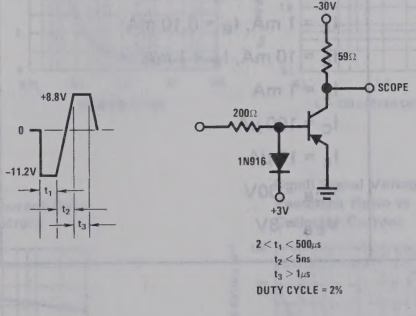
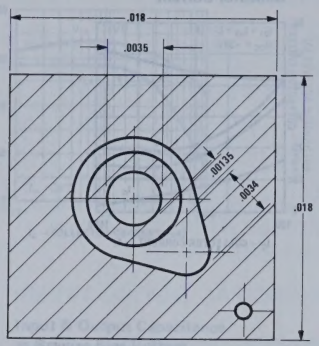


FIGURE 2. t_{off} Equivalent Test Circuit

Process 71 PNP Small Signal



DESCRIPTION

Process 71 is a nonoverlay, double diffused, silicon device. Complement to Process 04.

APPLICATION

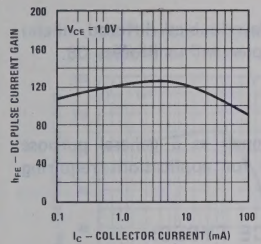
This device was designed for general purpose amplifier applications at collector currents to 20 mA.

PRINCIPAL DEVICE TYPES:

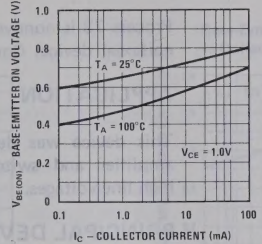
TO-18	BC177 Series
TO-106	BC251 Series

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
NF (spot)	I_C = 200 μA, V_C = 5V, R_S = 2k, f = 1 kHz		0.5	2.50	dB	
h_{fe}	I_C = 10 mA, V_{CE} = 5V, f = 100 MHz	3	5			
C_{ob}	V_{CB} = 10V		4	6	pF	TO-18
C_{ib}	V_{EB} = 0.50V		8	12	pF	TO-18
h_{FE}	I_C = 100 μA, V_{CE} = 1V	40	140	400		
h_{FE}	I_C = 1 mA, V_{CE} = 1V	40	140	400		
h_{FE}	I_C = 10 mA, V_{CE} = 1V	40	130			
h_{FE}	I_C = 20 mA, V_{CE} = 1V	40	125			
$V_{CE(SAT)}$	I_C = 1 mA, I_B = 0.10 mA		0.04	0.10	V	
$V_{CE(SAT)}$	I_C = 10 mA, I_B = 1 mA		0.055	0.11	V	
$V_{BE(SAT)}$	I_C = 1 mA, I_B = 0.10 mA		0.8	0.95	V	
$V_{BE(SAT)}$	I_C = 10 mA, I_B = 1 mA		0.9	1.0	V	
BV_{CEO}	I_C = 1 mA	40	50		V	
BV_{CBO}	I_C = 100 μA	40			V	
BV_{EBO}	I_E = 10 μA	5	6		V	
I_{CBO}	V_{CB} = 30V			50	nA	
I_{EBO}	V_{EB} = 3V			50	nA	

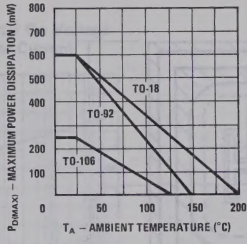
DC Pulse Current Gain vs Collector Current



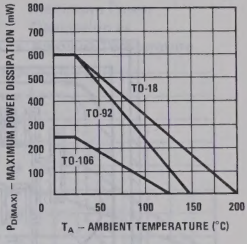
Base-Emitter On Voltage vs Collector Current



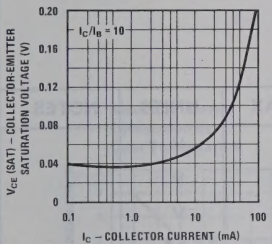
Maximum Power Dissipation vs Ambient Temperature



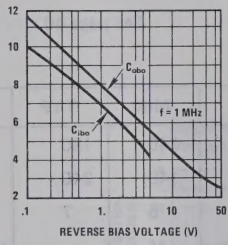
Maximum Power Dissipation vs Case Temperature



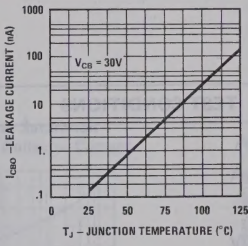
Collector-Emitter Saturation Voltage vs Collector Current



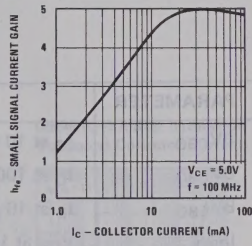
Capacitance vs Reverse Bias Voltage



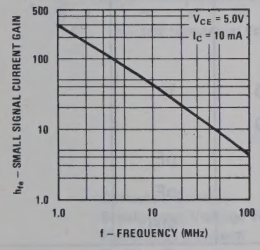
Collector-Base Diode Reverse Current vs Temperature



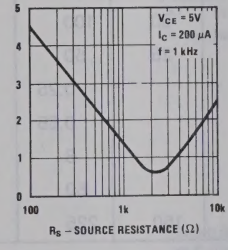
Small Signal Current Gain vs Collector Current



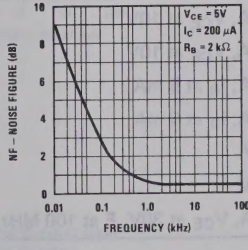
Capacitance vs Reverse Bias Voltage



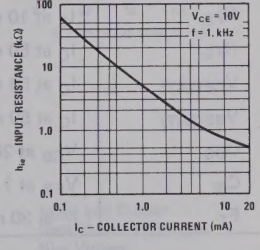
Noise Figure vs Source Resistance



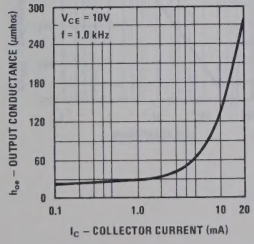
Noise Figure vs Frequency



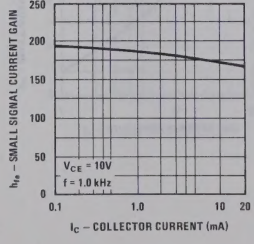
Small Signal Input Resistance vs Collector Current



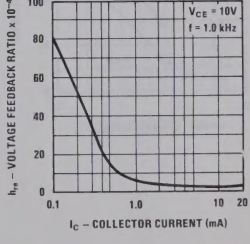
Small Signal Output Conductance vs Collector Current



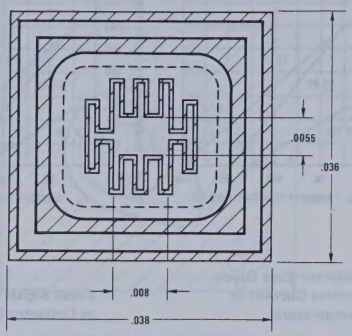
Small Signal Current Gain vs Collector Current



Small Signal Voltage Feedback Ratio vs Collector Current



Process 73 PNP High Voltage



DESCRIPTION

Process 73 is nonoverlay doubled diffused, silicon epitaxial device. Complement to Process 08.

APPLICATION

This device was designed as a general purpose amplifier and switch for applications requiring high line voltages.

PRINCIPAL DEVICE TYPES:

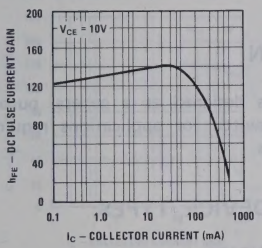
TO-39 2N3634

OTHER DEVICE TYPES

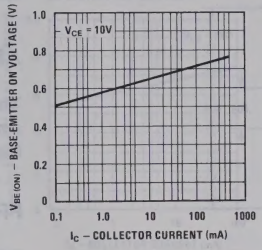
See page 46.

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
BV_{CEO}	I_C at 10 mA	140	180		V	
BV_{CBO}	I_C at 100 μA	140	240		V	
BV_{EBO}	I_E at 10 μA	5	7		V	
I_{CBO}	V_{CB} at 100V			100	nA	
I_{EBO}	V_{EB} at 3V			50	nA	
H_{FE}	I_C at 0.1 mA, V_{CE} at 10V	40	80			
H_{FE}	I_C at 1 mA, V_{CE} at 10V	45	90			
H_{FE}	I_C at 10 mA, V_{CE} at 10V	50	100			
H_{FE}	I_C at 50 mA, V_{CE} at 10V	25	50			
$V_{CE(SAT)}$	I_C at 50 mA, I_B at 5 mA		0.25	0.5	V	
$V_{BE(SAT)}$	I_C at 50 mA, I_B at 5 mA		0.65	0.9		
C_{OB}	V_{CB} at 20V		8	10	pF	
C_{IB}	V_{EB} at 1.0V		50	75	pF	
F_T	I_C at 30 mA, V_{CE} at 30V, F at 100 MHz	150	225		MHz	

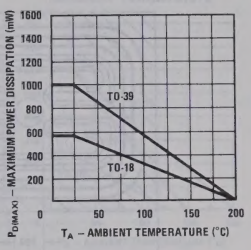
DC Pulse Current Gain vs Collector Current



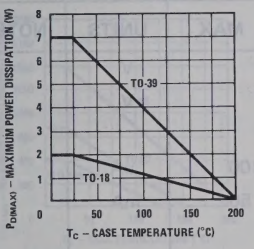
Base-Emitter On Voltage vs Collector Current



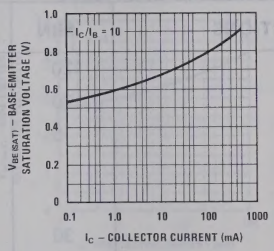
Maximum Power Dissipation vs Ambient Temperature



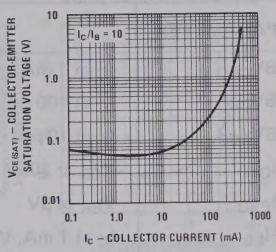
Maximum Power Dissipation vs Case Temperature



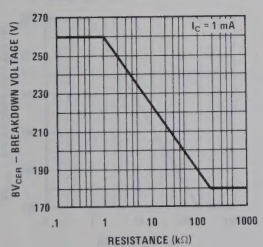
Base-Emitter Saturation Voltage vs Collector Current



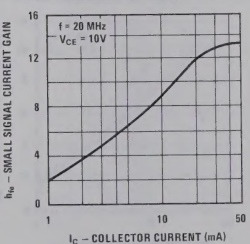
Collector-Emitter Saturation Voltage vs Collector Current



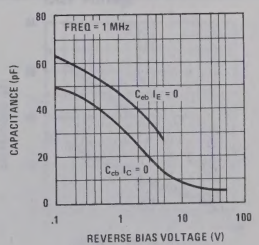
Collector-Emitter Breakdown Voltage With Resistance Between Emitter-Base



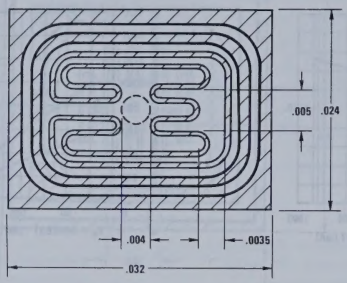
Small Signal Current Gain vs Collector Current



Input and Output Capacitance vs Reverse Bias Voltage



Process 74 PNP High Voltage



DESCRIPTION

Process 74 is nonoverlay double diffused, silicon epitaxial device. Complement to Process 16.

APPLICATION

This device was designed as a general purpose amplifier and switch for applications requiring high line voltages

PRINCIPAL DEVICE TYPES:

TO-92 2N5401

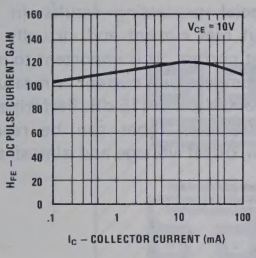
OTHER DEVICE TYPES

See page 46.

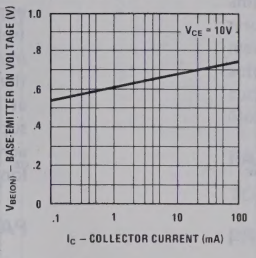
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
BV_{CEO}	I_C at 1 mA	120	170		V	
BV_{CBO}	I_C at 100 μA	130	220		V	
BV_{EBO}	I_E at 10 μA	5	6.5			
I_{CBO}	V_{CB} at 100V			100	nA	
I_{EBO}	V_{EB} at 3V			50	nA	
H_{FE}	I_C at 1 mA, V_{CE} at 5V	30	60			
H_{FE}	I_C at 10 mA, V_{CE} at 5V	40	100	240		
H_{FE}	I_C at 50 mA, V_{CE} at 5V	40	60			
$V_{CE(SAT)}$	I_C at 50 mA, I_B at 5 mA		0.18	0.25		
$V_{BE(SAT)}$	I_C at 50 mA, I_B at 5 mA		0.75	1.0		
C_{OB}	V_{CB} at 10V		5	6.0	pF	
F_T	I_C at 10 mA, V_{CE} at 10V, F at 100 MHz	100	200	400	MHz	

Process 74

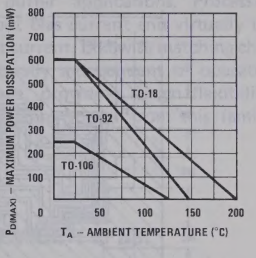
DC Pulse Current Gain vs Collector Current



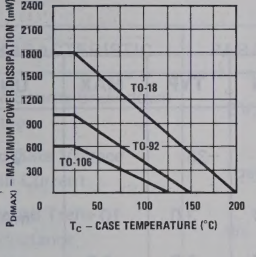
Base-Emitter On Voltage vs Collector Current



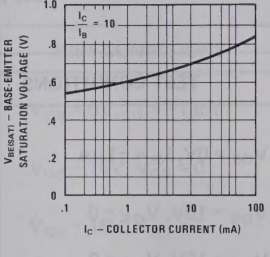
Maximum Power Dissipation vs Ambient Temperature



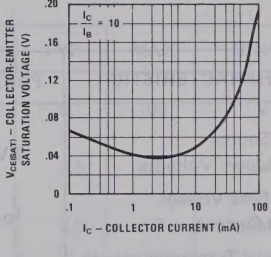
Maximum Power Dissipation vs Case Temperature



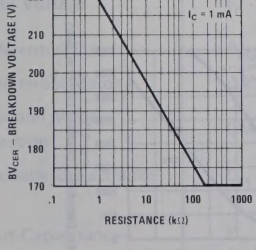
Base-Emitter Saturation Voltage vs Collector Current



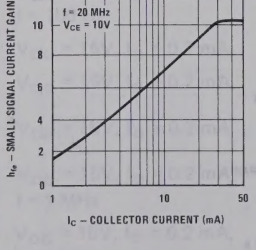
Collector-Emitter Saturation Voltage vs Collector Current



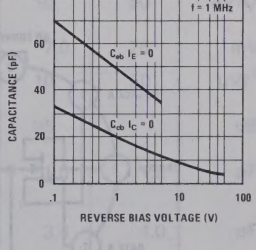
Collector-Emitter Breakdown Voltage With Resistance Between Base-Emitter



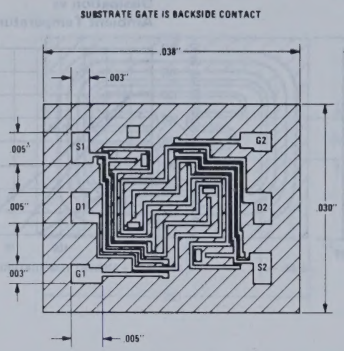
Small Signal Current Gain vs Collector Current



Input and Output Capacitance vs Reverse Bias Voltage



Process 82 N-Channel Junction FET



Note: Device not recommended for new designs.

DESCRIPTION

Process 82 is a monolithic dual JFET. It is strictly intended for operational amplifier input buffer applications. Special processing results in extremely low input bias current and virtually unmeasureable offset current. It is important to note that the sub-pico ampere bias current is measured at 35 volts. Typical CMRR is 115 dB. Performance superior to electrometer tubes can be readily achieved with low offset voltage and almost zero long term drift.

PACKAGES:

TO-99

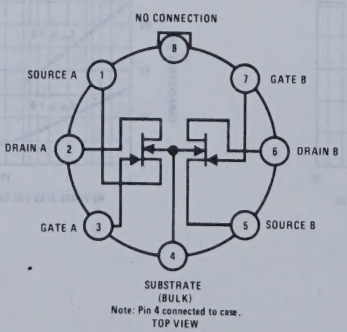
PRINCIPAL DEVICE TYPES:

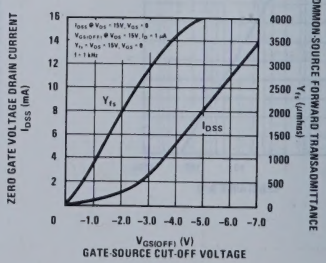
FM1100A SERIES

OTHER DEVICE TYPES

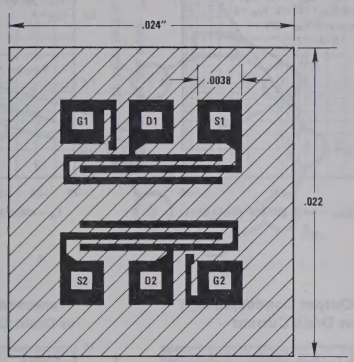
See page 56.

CHARACTERISTIC	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Gate-Source Breakdown Voltage	BV_{GSS}	V_{DS} = 0V, I_G = −1 μA	−20	−35		V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = 15V, V_{GS} = 0	0.1	3.0	10	mA
Forward Transconductance	g_{fs}	V_{DS} = 15V, V_{GS} = 0	0.5	3.0	6.0	mmho
Pinch Off Voltage	$V_{GS(OFF)}$	V_{DS} = 15V, I_D = 1 μA	−0.5	−3.0	−6.0	V
Gate Current	I_G	V_{DG} = 35V, I_D = 0.10 mA		0.4	10	pA
Feedback Capacitance	C_{rss}	V_{DG} = 15V, V_{GS} = 0, f = 1 MHz		0.3	0.6	pF
Input Capacitance	C_{is}	V_{DS} = 15V, I_D = 0.1 mA, f = 1 MHz		3.5	5.0	pF





Process 83 N-Channel Junction FET



DESCRIPTION

Process 83 is a monolithic dual JFET with a diode isolated substrate. It is intended for operational amplifier input buffer applications. Processing results in low input bias current and virtually unmeasureable offset current. Likewise matching characteristics are virtually independent of operating current and voltage, providing design flexibility. Most GP 2N types are sorted from this family.

PACKAGES:

TO-71

PRINCIPAL DEVICE TYPES:

2N5196-99	2N3954-58	U231-235
2N5561-3	2N5045-47	2N3921-22
2N5452-4	2N5545-47	2N4084-85

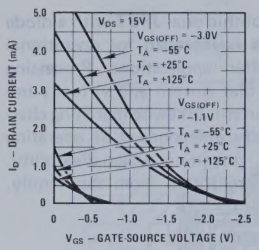
OTHER DEVICE TYPES

See page 54.

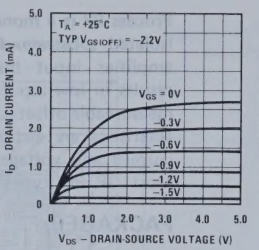
CHARACTERISTIC	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Gate-Source Breakdown Voltage	BV_{GSS}	V_{DS} = 0V, I_G = −1 μA	−50	−70	−100	V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = 15V, V_{GS} = 0	0.5	2.5	8.0	mA
Forward Transconductance	g_{fs}	V_{DS} = 15V, V_{GS} = 0	1.0	2.5	5.0	mmho
Pinch Off Voltage	$V_{GS(OFF)}$	V_{DS} = 15V, I_D = 1 μA	−0.5	−2.0	−4.5	V
Gate Current	I_G	V_{DG} = 20V, I_D = 0.2 mA		3.0	50	pA
Forward Transconductance	g_{fs}	V_{DG} = 15V, I_D = 0.2 mA	600	850		μmhos
Output Conductance	g_{os}	V_{DG} = 15V, I_D = 0.2 mA		1.0	5.0	μmhos
"ON" Resistance	r_{DS}	V_{DS} = 100 mV, V_{GS} = 0		450		Ω
Noise Voltage	$\bar{e}_n$	V_{DG} = 15V, I_D = 0.2 mA f = 100 Hz		10	50	$nV/\sqrt{Hz}$
Differential Match	$\lvert V_{GS1}-V_{GS2}\rvert$	V_{DG} = 15V, I_D = 0.2 mA		7.0	25	mV
Differential Match	ΔV_{GS1-2}	V_{DG} = 15V, I_D = 0.2 mA		10	50	μV/°C
Common Mode Rejection	CMRR	V_{DG} = 15V, I_D = 0.2 mA	80	95		dB
Feedback Capacitance	C_{rs}	V_{DG} = 15V, I_D = 0.2 mA, f = 1 MHz		1.0	1.2	pF
Input Capacitance	C_{is}	V_{DG} = 15V, I_D = 0.2 mA, f = 1 MHz		3.4	4.0	pF

Process 83

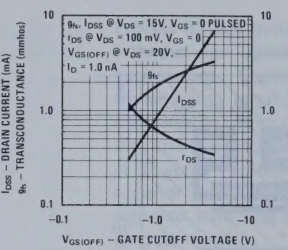
Transfer Characteristics



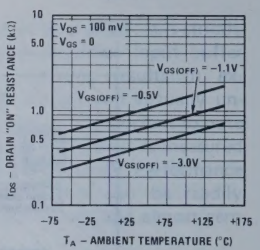
Common Drain-Source Characteristics



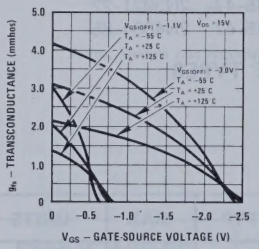
Parameter Interactions


g_{fs}, I_{DSS} @ V_{DS} = 15V, V_{GS} = 0 PULSED
r_{DS} @ V_{DS} = 100 mV, V_{GS} = 0
$V_{GS(OFF)}$ @ V_{DS} = 20V, I_D = 1.0 nA
g_{fs}
I_{DSS}
r_{DS}
I_{DSS} – DRAIN CURRENT (mA)
g_{fs} – TRANSCONDUCTANCE (mmhos)
r_{DS} – DRAIN "ON" RESISTANCE (kΩ)
$V_{GS(OFF)}$ – GATE CUTOFF VOLTAGE (V)

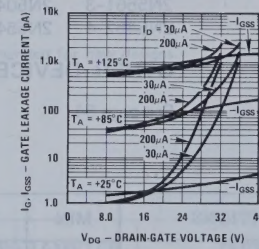
Channel Resistance vs Temperature



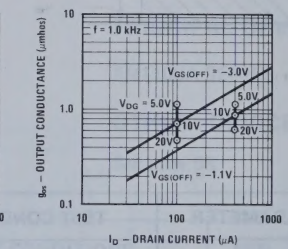
Transfer Characteristics



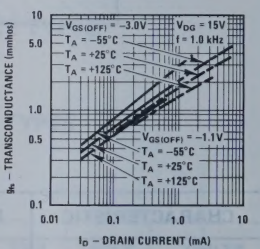
Leakage Current vs Voltage



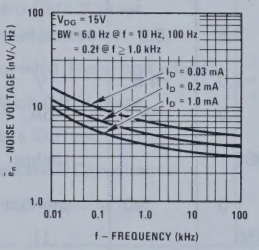
Output Conductance vs Drain Current



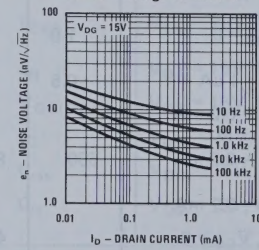
Transconductance vs Drain Current



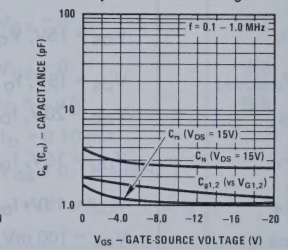
Noise Voltage vs Frequency



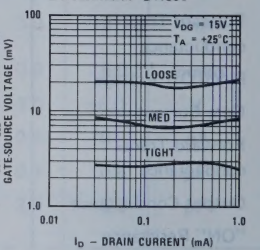
Noise Voltage vs Current



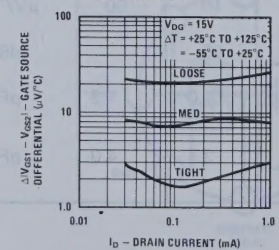
Capacitance vs Voltage



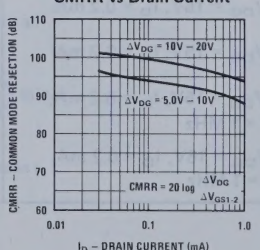
Differential Offset

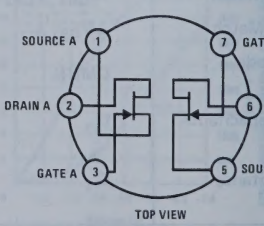


Differential Drift

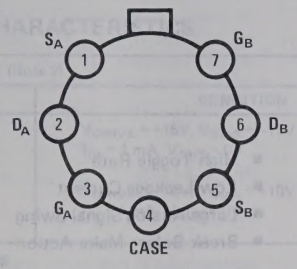


CMRR vs Drain Current


ΔV_{DG} = 10V – 20V
ΔV_{DG} = 5.0V – 10V
CMRR = 20 log $\frac{\Delta V_{DG}}{\Delta V_{GS1,2}}$
CMRR – COMMON MODE REJECTION (dB)
I_D – DRAIN CURRENT (mA)



Process 84 N-Channel Junction FET



TOP VIEW

DESCRIPTION

Process 84 is a monolithic dual JFET with a diode isolated substrate. It is designed for the most critical operational amplifier input stages or electrometer single ended preamp. Ideal for medical applications and instrumentation inputs where subpicoamp inputs are important. Device design considered high CMRR, subpicoamp leakage over wide input swings, low capacitance, and tight match over wide current range.

PACKAGES:

TO-78

PRINCIPAL DEVICE TYPES:

2N5902-9

OTHER DEVICE TYPES

See page 56.

DEVICE UNDER DEVELOPMENT. CONSULT FACTORY REPRESENTATIVE FOR DELIVERY STATUS.

Process 87 Analog Switches

AM1000, AM1001, AM1002 SILICON N-CHANNEL HIGH SPEED ANALOG SWITCH

DESCRIPTION

The AM1000 series are junction FET integrated circuit analog switches. These devices commutate faster and with less voltage spiking than any other analog switch presently available. By comparison, discrete JFET switches require elaborate drive circuits to obtain reasonable performance for high toggle rates. Encapsulated in a four pin TO-72 package, these units require a minimum of circuit board area. Switching transients are greatly reduced by a monolithic integrated circuit process. The resulting analog switch device provides the following features:

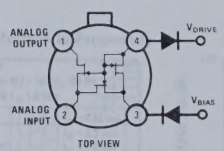
- Low ON Resistance 30Ω
- High Analog Signal Frequency 100 MHz
- High Toggle Rate 4 MHz
- Low Leakage Current 250 pA
- Large Analog Signal Swing ±15V
- Break Before Make Action

The AM1000 series of analog switches are particularly suitable for the following applications:

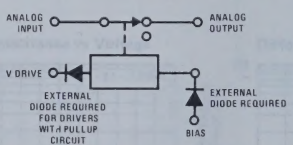
- High Speed Commutators
- Multiplexers
- Sample and Hold Circuits
- Reset Switching
- Video Switching

SCHEMATIC DIAGRAM

TO-72 Package

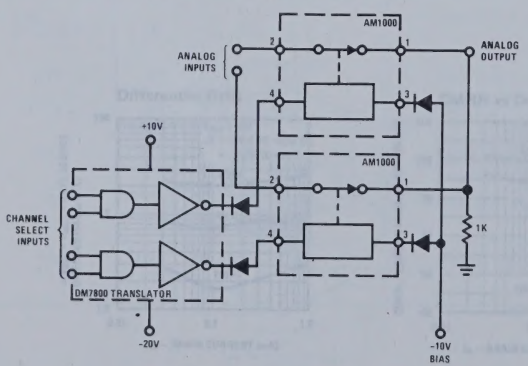


EQUIVALENT CIRCUIT

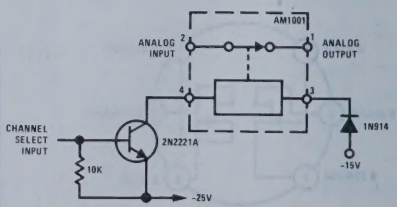


TYPICAL APPLICATIONS

±10 Volt Swing Analog Switch 0.5% Accuracy



±15 Volt Swing Analog Switch



Process 87

ABSOLUTE MAXIMUM RATINGS

	AM1001	AM1000 AM1002
V_{IN} (Note 1)	+50V	+40V
V_{OUT} (Note 1)	+50V	+40V
V_{DRIVE} (Note 1)	−50V	−40V
V_{BIAS} (Note 1)	+50V	+40V

Power Dissipation @ $T_A = 25°C$	300 mW
Linear Derating Factor	1.7 mW/°C
Power Dissipation @ $T_C = 125°C$	150 mW
Linear Derating Factor	6 mW/°C
Maximum Junction Operating Temperature	−55°C to +150°C
Storage Temperature	+200°C
Lead Temperature (Solding, 10 sec)	+300°C

ELECTRICAL CHARACTERISTICS

ON CHARACTERISTICS (Note 2)

PARAMETER	CONDITION		MIN	TYP	MAX	UNITS
R_{ON}	$V_{DRIVE} = +15V$, $V_{BIAS} = -15V$ $I_{IN} = 1$ mA, $V_{OUT} = 0V$	AM1001	20	40	50	Ω
R_{ON}	$V_{DRIVE} = +10V$, $V_{BIAS} = -10V$ $I_{IN} = 1$ mA, $V_{OUT} = 0V$	AM1000 AM1002	20 20	25 50	30 100	Ω Ω

OFF CHARACTERISTICS

PARAMETER	CONDITION	AM1000 AM1001			AM1002			UNITS
		MIN	TYP	MAX	MIN	TYP	MAX	
$I_{OUT(OFF)}$	$V_{DRIVE} = -20V$, $V_{BIAS} = -10V$ $V_{IN} = 10V$, $V_{OUT} = +10V$							
	$T_A = +25°C$		.05	.25		0.5	1	nA
	$T_A = +125°C$		.025	.25		0.2	1	μA
$I_{OUT(OFF)}$	$V_{DRIVE} = -20V$, $V_{BIAS} = -10V$ $V_{IN} = +10V$, $V_{OUT} = -10V$							
	$T_A = +25°C$		.05	.25		0.5	1	nA
	$T_A = +125°C$		.05	.25		0.2	1	μA

DRIVE CHARACTERISTICS (Note 3)

PARAMETER	CONDITION	MIN	TYP	MAX	UNITS
I_{DRIVE} (Switch OFF)	$V_{DRIVE} = -20V$, $V_{BIAS} = -10V$ AM1000, 1001, 1002 $V_{IN} = \pm 10V$, $V_{OUT} = \pm 10V$		5	10	mA

SWITCHING CHARACTERISTICS

PARAMETER	CONDITION	AM1000 MAX	AM1001 MAX	AM1002 MAX	UNITS
t_{ON}	See Switching	100	150	200	ns
t_{OFF}	Time Test Circuit	100	100	100	ns

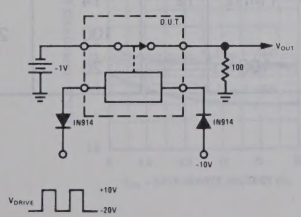
Note 1: The maximum voltage ratings may be applied between any pin or pins simultaneously. Power dissipation may be exceeded in some modes if the voltage pulse exceeds 10 ms. Normal operation will not cause excessive power dissipation even in a "DC" switching application.

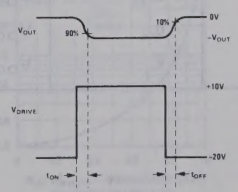
Note 2: All parameters are measured with external silicon diodes. See electrical connection diagram for proper diode placement.

Note 3: I_{BIAS} (Switch OFF) is equal to I_{DRIVE} (Switch OFF). $I_{(BIAS)}$ (Switch ON), is equal to external diode leakage.

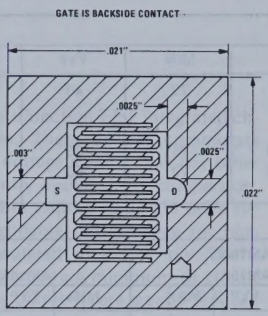
Note 4: Rise and fall times of V_{DRIVE} shall be 15 ns maximum for switching time testing.

SWITCHING TIME TEST CIRCUIT AND WAVEFORMS





Process 88 P-Channel Junction FET



DESCRIPTION

Process 88 is designed primarily for electronic switching applications where a P channel device is desirable. Inherent zero offset voltage, low leakage and low $R_{DS(ON)}$ C_{iss} time constant make this device excellent for low level analog switching, sample and hold circuits and chopper stabilized amplifiers. This device is the compliment to Process 51.

PACKAGES:

TO-18P, TO-72, TO-106

PRINCIPAL DEVICE TYPES:

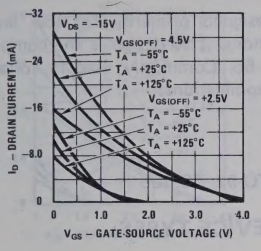
2N3382-86
2N5114-16
P1086-7E
2N3993-94, A
2N5018-21

OTHER DEVICE TYPES

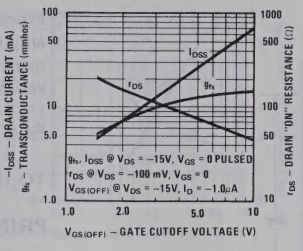
See pages 57 and 58.

CHARACTERISTIC	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Gate-Source Breakdown Voltage	BV_{GSS}	V_{DS} = 0V, I_G = 1 μA	30	40	50	V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = −15V, V_{GS} = 0	−5.0	−30	−90	mA
Forward Transconductance	g_{fs}	V_{DS} = −15V, V_{GS} = 0	4.0	13	17	mmhos
Forward Transconductance	g_{fs}	V_{DG} = −15V, I_D = −2 mA		3.5		mmhos
Gate Leakage	I_{GSS}	V_{GS} = 20V, V_{DS} = 0		0.05	1.0	nA
"ON" Resistance	r_{DS}	V_{DS} = −100 mV, V_{GS} = 0	50	80	200	Ω
Pinch Off Voltage	$V_{GS(OFF)}$	V_{DS} = −15V, I_D = −1 nA	0.5	5.0	10	V
Drain "OFF" Current	$I_{D(OFF)}$	V_{DS} = −15V, V_{GS} = 10V		−0.05	−10	nA
Feedback Capacitance	C_{rss}	V_{DG} = −15V, I_D = −2 mA, f = 1 MHz	3.0	4.0	5.0	pF
Input Capacitance	C_{iss}	V_{DS} = −15V, I_D = −2 mA, f = 1 MHz	12	14	15	pF
Output Conductance	g_{os}	V_{DG} = −15V, I_D = −2 mA		100	200	μmhos
Noise Voltage	$\bar{e}_n$	V_{DG} = −15V, I_D = −2 mA, f = 100 Hz		20		$nV/\sqrt{Hz}$

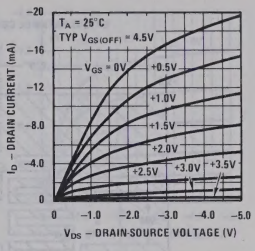
Transfer Characteristics



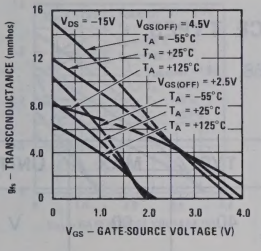
Parameter Interactions


I_{DSS}
r_{DS}
g_{fs}
g_{fs}, I_{DSS} @ V_{DS} = −15V, V_{GS} = 0 PULSED
r_{DS} @ V_{DS} = −100 mV, V_{GS} = 0
$V_{GS(OFF)}$ @ V_{DS} = −15V, I_D = −1.0μA
$-I_{DSS}$ – DRAIN CURRENT (mA)
g_{fs} – TRANSCONDUCTANCE (mmhos)
r_{DS} – DRAIN "ON" RESISTANCE (Ω)
$V_{GS(OFF)}$ – GATE CUTOFF VOLTAGE (V)

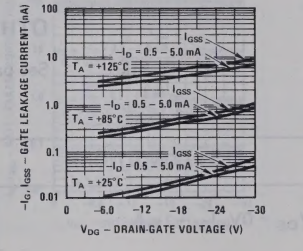
Common Drain-Source Characteristics



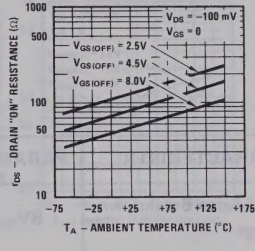
Transfer Characteristics



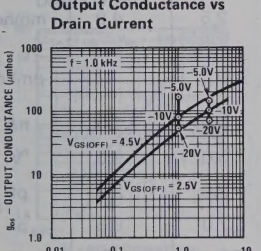
Leakage Current vs Voltage



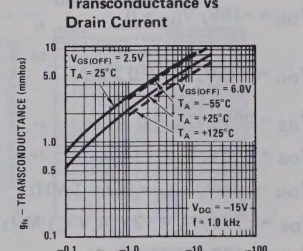
Channel Resistance vs Temperature



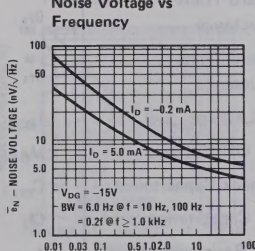
Output Conductance vs Drain Current



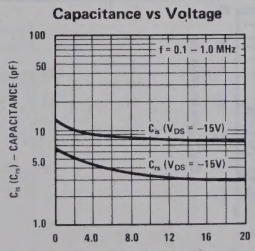
Transconductance vs Drain Current



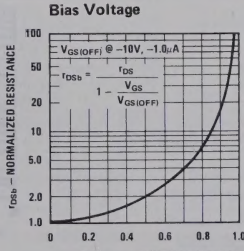
Noise Voltage vs Frequency



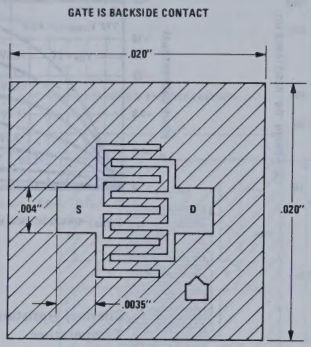
Capacitance vs Voltage



Normalized Drain Resistance vs Bias Voltage


$V_{GS(OFF)}$ @ −10V, −1.0μA
$r_{DSb} = \frac{r_{DS}}{1 - \frac{V_{GS}}{V_{GS(OFF)}}}$
r_{DSb} – NORMALIZED RESISTANCE
$|V_{GS}/V_{GS(OFF)}|$ – NORMALIZED GATE-TO-SOURCE VOLTAGE (V)

Process 89 P-Channel Junction FET



DESCRIPTION

Process 89 is designed primarily for low level amplifier applications. This device is the complement to Process 55. Commonly used in voltage variable resistor applications.

PACKAGES:

TO-18P, TO-72, TO-92, TO-106

PRINCIPAL DEVICE TYPES:

2N2608-9
2N4381
2N5460-62
2N3329-32

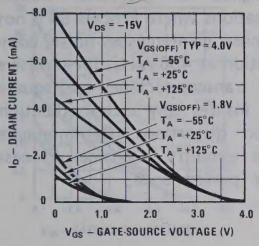
OTHER DEVICE TYPES

See pages 57 and 58.

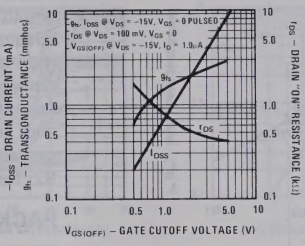
CHARACTERISTIC	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Gate-Source Breakdown Voltage	BV_{GSS}	V_{DS} = 0V, I_G = 1 μA	20	40	60	V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = −15V, V_{GS} = 0	−0.3	−4.0	−20	mA
Forward Transconductance	g_{fs}	V_{DS} = −15V, V_{GS} = 0	1.0	2.5	4.0	mmhos
Forward Transconductance	g_{fs}	V_{DG} = −15V, I_D = −0.2 mA		700		μmhos
Gate Leakage	I_{GSS}	V_{GS} = 20V, V_{DS} = 0		0.02	1.0	nA
Pinch Off Voltage	$V_{GS(OFF)}$	V_{DS} = −15V, I_D = −1 nA	0.5	3.0	9.0	V
Feedback Capacitance	C_{rss}	V_{DG} = −15V, V_{GS} = 0, f = 1 MHz		2.0	2.5	pF
Input Capacitance	C_{is}	V_{DS} = −15V, I_D = −2 mA, f = 1 MHz		7.0	8.5	pF
"ON" Resistance	r_{DS}	V_{DS} = −100 mV, V_{GS} = 0		450		Ω
Output Conductance	g_{os}	V_{DG} = −15V, I_D = −0.2 mA		5.0	15	μmhos
Noise Voltage	$\bar{e}_n$	V_{DG} = −15V, I_D = −0.2 mA, f = 100 Hz		30		$nV/\sqrt{Hz}$

Process 89

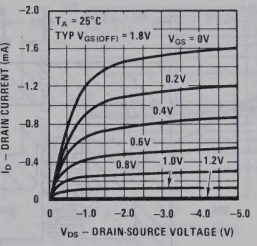
Transfer Characteristics



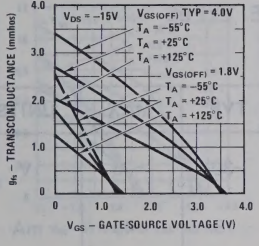
Parameter Interactions


g_{fs}, I_{DSS} @ V_{DS} = −15V, V_{GS} = 0 PULSED
r_{DS} @ V_{DS} = 100 mV, V_{GS} = 0
$V_{GS(OFF)}$ @ V_{DS} = −15V, I_D = 1.0μA
g_{fs}
r_{DS}
I_{DSS}
$-I_{GSS}$ – DRAIN CURRENT (mA)
g_{fs} – TRANSCONDUCTANCE (mmhos)
r_{DS} – DRAIN "ON" RESISTANCE (kΩ)
$V_{GS(OFF)}$ – GATE CUTOFF VOLTAGE (V)

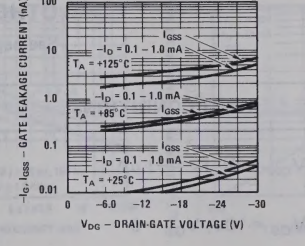
Common Drain-Source Characteristics



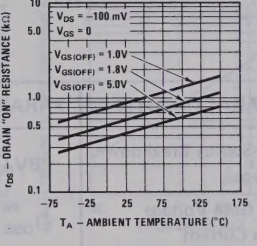
Transfer Characteristics



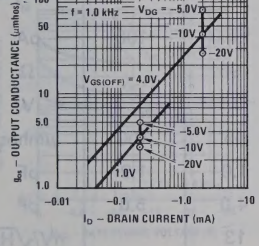
Leakage Current vs Voltage



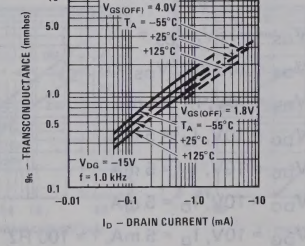
Channel Resistance vs Temperature



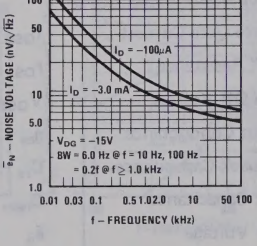
Output Conductance vs Drain Current



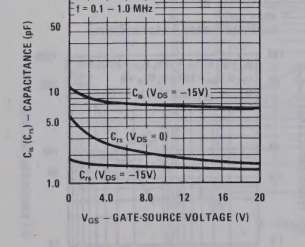
Transconductance vs Drain Current



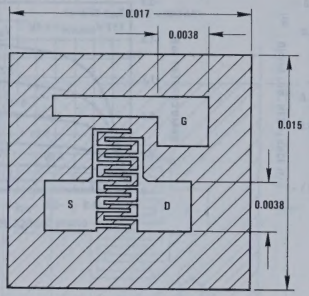
Noise Voltage vs Frequency



Capacitance vs Voltage



Process 90 N-Channel Junction FET



DESCRIPTION

Process 90 is designed for VHF/UHF mixer/amplifier and applications where Process 50 is not adequate. Has sufficient gain and low noise, common gate configuration at 450 MHz, for sensitive receivers. The high transconductance and square law characteristics insures low crossmodulation and intermodulation distortions. Common-gate operation simplifies circuitry. Consider Process 92 for even higher performance.

PACKAGES:

TO-72, TO-106

PRINCIPAL DEVICE TYPES:

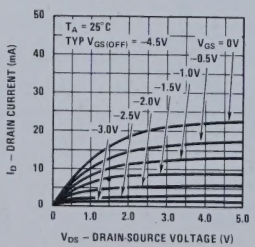
2N5397-8, E300

OTHER DEVICE TYPES

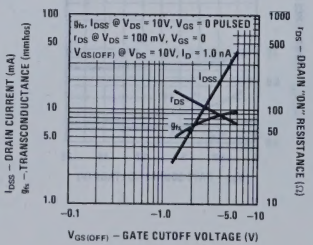
See page 49.

CHARACTERISTIC	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Gate-Source Breakdown Voltage	BV_{GSS}	V_{DS} = 0V, I_G = −1 μA	−20	−30	−35	V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = 10V, V_{GS} = 0	3	18	40	mA
Forward Transconductance	g_{fs}	V_{DS} = 10V, V_{GS} = 0	5.5	8.0	10	mmhos
Forward Transconductance	g_{fs}	V_{DS} = 10V, I_D = 5 mA	4.5	5.8		mmhos
Reverse Gate Current	I_{GSS}	V_{GS} = −15V, V_{DS} = 0		−5.0	−100	pA
"ON" Resistance	r_{DS}	V_{DS} = 100 mV, V_{GS} = 0		90		Ω
Pinch Off Voltage	$V_{GS(OFF)}$	V_{DS} = 10V, I_D = 1 nA	−1.5	−3.5	−6.0	V
Output Conductance	g_{os}	V_{DG} = 10V, I_D = 5 mA		45	100	μmhos
Feedback Capacitance	C_{rs}	V_{DG} = 10V, I_D = 5 mA		1.0	1.2	pF
Input Capacitance	C_{is}	V_{DG} = 10V, I_D = 5 mA		4.0	5.0	pF
Noise Voltage	$\bar{e}_n$	V_{DG} = 10V, I_D = 5 mA, f = 100 Hz		13		$nV/\sqrt{Hz}$
Noise Figure	NF	V_{DG} = 10V, I_D = 5 mA, f = 450 MHz		3.0		dB
Power Gain	G_{pg} (CG)	V_{DG} = 10V, I_D = 5 mA, f = 450 MHz		11		dB

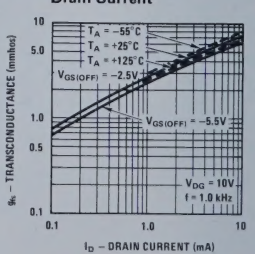
Common Drain-Source Characteristics



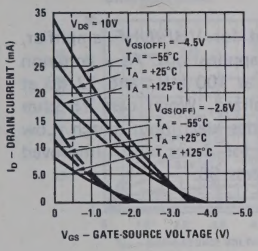
Parameter Interactions


g_{fs}, I_{DSS} @ V_{DS} = 10V, V_{GS} = 0 PULSED
r_{DS} @ V_{DS} = 100 mV, V_{GS} = 0
$V_{GS(OFF)}$ @ V_{DS} = 10V, I_D = 1.0 mA
I_{DSS}
r_{DS}
g_{fs}
I_{DSS} – DRAIN CURRENT (mA)
g_{fs} – TRANSCONDUCTANCE (mmhos)
r_{DS} – DRAIN "ON" RESISTANCE (Ω)
$V_{GS(OFF)}$ – GATE CUTOFF VOLTAGE (V)

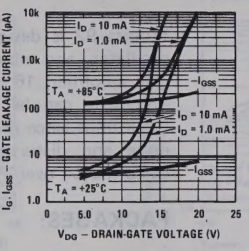
Transconductance vs Drain Current



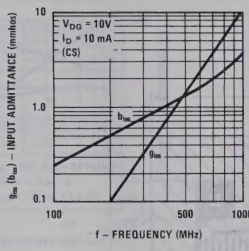
Transfer Characteristics



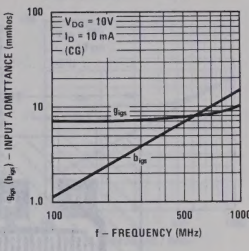
Leakage Current vs Voltage



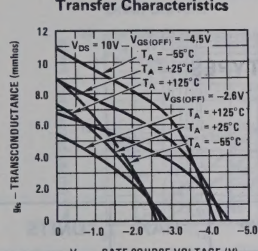
Input Admittance



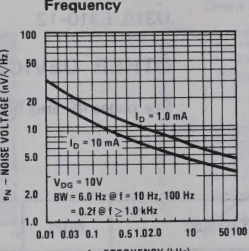
Input Admittance



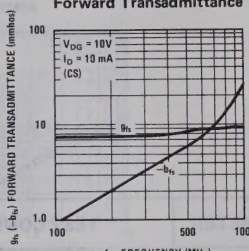
Transfer Characteristics



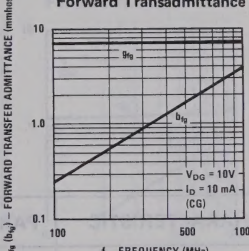
Noise Voltage vs Frequency



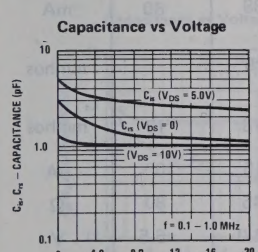
Forward Transadmittance



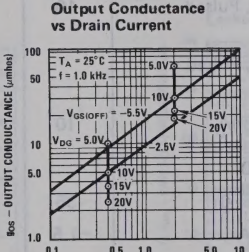
Forward Transadmittance



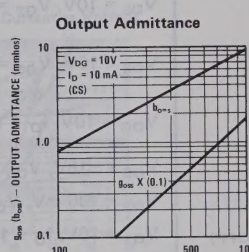
Capacitance vs Voltage



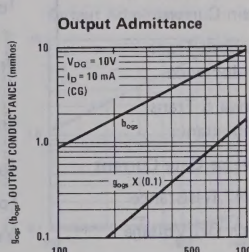
Output Conductance vs Drain Current



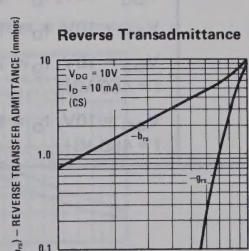
Output Admittance



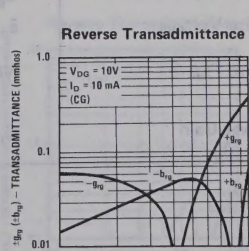
Output Admittance



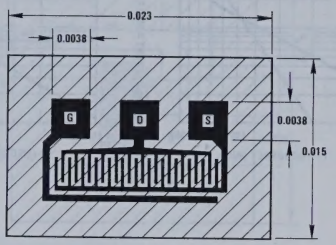
Reverse Transadmittance



Reverse Transadmittance



Process 92 N-Channel Junction FET



DESCRIPTION

Process 92 is designed for VHF/UHF amplifier, oscillator, and mixer applications. As a common gate amplifier, 16 dB at 100 MHz and 12 dB at 450 MHz can be realized. Worst case 75 ohm input impedance provides ideal input match. Low noise and distortion for front end. Improved performance over Process 90.

PACKAGES:

TO-52, TO-106

PRINCIPAL DEVICE TYPES:

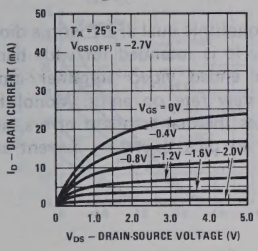
U310, E310-12

OTHER DEVICE TYPES

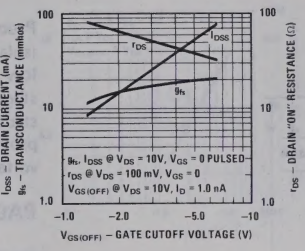
See pages 49 and 50.

CHARACTERISTIC	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Gate-Source Breakdown Voltage	BV_{GSS}	V_{DS} = 0V, I_G = −1 μA	−20	−30	−35	V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = 10V, V_{GS} = 0, Pulsed	10	38	80	mA
Forward Trans-conductance	g_{fs}	V_{DS} = 10V, V_{GS} = 0, Pulsed		19		mmhos
Forward Trans-conductance	g_{fs}	V_{DG} = 10V, I_D = 10 mA	10	13	18	mmhos
Reverse Gate Current	I_{GSS}	V_{GS} = −15V, V_{DS} = 0		−15	−100	pA
"ON" Resistance	r_{DS}	V_{DS} = 100 mV, V_{GS} = 0	35	45	80	Ω
Pinch Off Voltage	$V_{GS(OFF)}$	V_{DS} = 10V, I_D = 1 nA	−1.5	−4.0	−6.5	V
Output Conductance	g_{os}	V_{DG} = 10V, I_D = 10 mA		160	250	μmhos
Feedback Capacitance	C_{gd}	V_{DG} = 10V, I_D = 10 mA, f = 1 MHz		2.0	2.5	pF
Input Capacitance	C_{gs}	V_{DG} = 10V, I_D = 10 mA, f = 1 MHz		4.1	5.0	pF
Noise Voltage	$\bar{e}_n$	V_{DG} = 10V, I_D = 10 mA, f = 100 Hz		6.0		$nV/\sqrt{Hz}$
Noise Figure	NF	V_{DG} = 10V, I_D = 10 mA, f = 450 MHz		3.0		dB
Power Gain	G_{pg}	V_{DG} = 10V, I_D = 10 mA, f = 450 MHz		12		dB

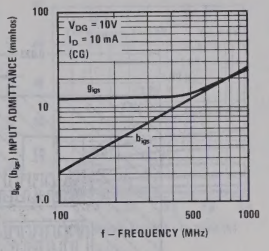
Common Drain-Source Characteristics



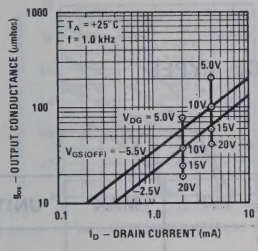
Parameter Interactions


r_{DS}
I_{DSS}
g_{fs}
g_{fs}, I_{DSS} @ V_{DS} = 10V, V_{GS} = 0 PULSED
r_{DS} @ V_{DS} = 100 mV, V_{GS} = 0
$V_{GS(OFF)}$ @ V_{DS} = 10V, I_D = 1.0 nA
I_{DSS} – DRAIN CURRENT (mA)
g_{fs} – TRANSCONDUCTANCE (mmhos)
r_{DS} – DRAIN "ON" RESISTANCE (Ω)
$V_{GS(OFF)}$ – GATE CUTOFF VOLTAGE (V)

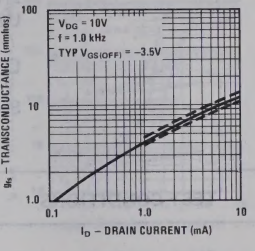
Input Admittance



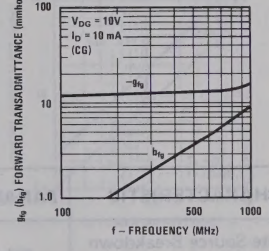
Output Conductance vs Drain Current



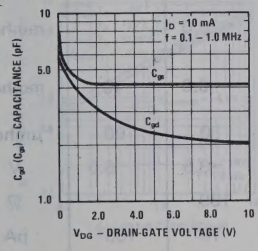
Transconductance vs Drain Current



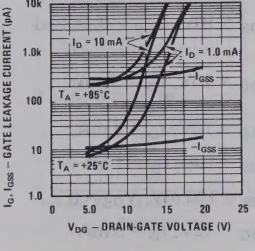
Forward Transadmittance



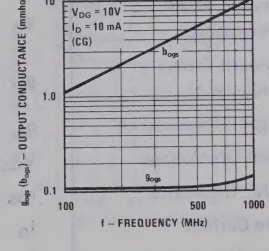
Capacitance vs Voltage



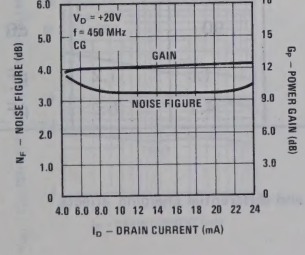
Leakage Current vs Voltage



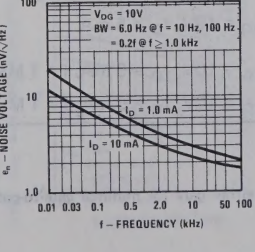
Output Admittance



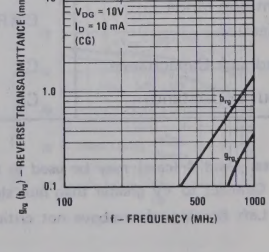
Noise Figure vs Power Gain



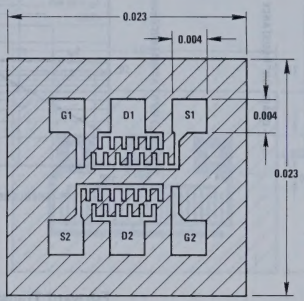
Noise Voltage vs Frequency



Reverse Transadmittance



Process 93 N-Channel Junction FET



DESCRIPTION

Process 93 is a monolithic dual JFET with a diode isolated substrate. It is intended for wide band, low noise, single ended video amplifier input stages, and high slew rate op amps. Monolithic structure eliminates thermal transient errors, and provides freedom to pick operating current and voltage.

PACKAGES:

TO-78

PRINCIPAL DEVICE TYPES:

2N5911, 12
U257

OTHER DEVICE TYPES

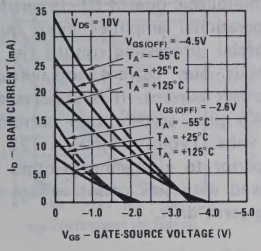
See page 55.

CHARACTERISTIC	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Gate-Source Breakdown Voltage	BV_{GSS}	V_{DS} = 0V, I_G = −1 μA	−25	−30	−40	V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = 10V, V_{GS} = 0, Pulsed	3.0	18	40	mA
Forward Trans-conductance	g_{fs}	V_{DS} = 10V, V_{GS} = 0, Pulsed		8.0		mmhos
Forward Trans-conductance	g_{fs}	V_{DG} = 10V, I_D = 5 mA	5.0	6.0	10	mmhos
Output Conductance	g_{os}	V_{DG} = 10V, I_D = 5 mA		50	100	μmhos
Pinch Off Voltage	$V_{GS(OFF)}$	V_{DS} = 10V, I_D = 1 nA	−1.5	−3.5	−6.0	V
"ON" Resistance	r_{DS}	V_{DS} = 100 mV, V_{GS} = 0		100		Ω
Gate Current	I_G	V_{DG} = 10V, I_D = 5 mA		10	100	pA
Noise Voltage	$\bar{e}_n$	V_{DG} = 10V, I_D = 5 mA, f = 100 Hz		9.0	30	$nV/\sqrt{Hz}$
Differential Match	$\lvert V_{GS1}-V_{GS2}\rvert$	V_{DG} = 10V, I_D = 5 mA		9.0	30	mV
Differential Match	ΔV_{GS1-2}	V_{DG} = 10V, I_D = 5 mA		15	40	μV/°C
Common Mode Rejection	CMRR	V_{DG} = 10V, I_D = 5 mA		90		dB
Feedback Capacitance	C_{rs}	V_{DG} = 10V, I_D = 5 mA, f = 1 MHz		1.0	1.2	pF
Input Capacitance	C_{is}	V_{DG} = 10V, I_D = 5 mA, f = 1 MHz		4.2	5.0	pF

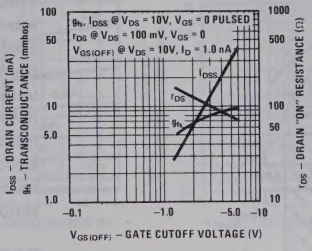
Note: Lead 4 (case) may be used in two ways:
A. Connect to +V greater than plus signal voltage on either gate for minimal gate-to-gate coupling and differential charging effects.
B. Left floating when above not critical.

Process 93

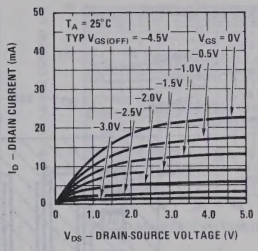
Transfer Characteristics



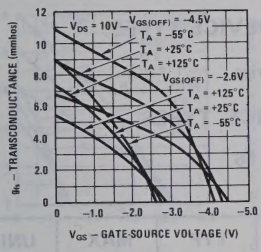
Parameter Interactions


g_{fs}, I_{DSS} @ V_{DS} = 10V, V_{GS} = 0 PULSED
r_{DS} @ V_{DS} = 100 mV, V_{GS} = 0
$V_{GS(OFF)}$ @ V_{DS} = 10V, I_D = 1.0 nA
I_{DSS}
r_{DS}
g_{fs}
I_{DSS} – DRAIN CURRENT (mA)
g_{fs} – TRANSCONDUCTANCE (mmhos)
r_{DS} – DRAIN "ON" RESISTANCE (Ω)
$V_{GS(OFF)}$ – GATE CUTOFF VOLTAGE (V)

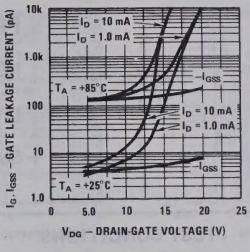
Common Drain-Source Characteristics



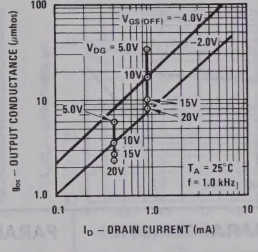
Transfer Characteristics



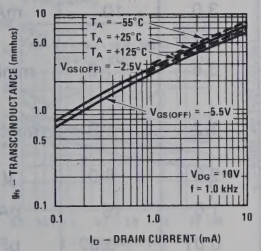
Leakage Current vs Voltage



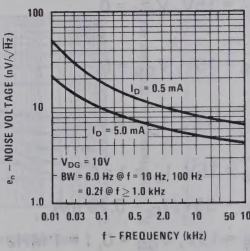
Output Conductance vs Drain Current



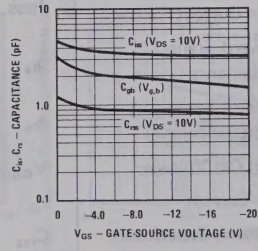
Transconductance vs Drain Current



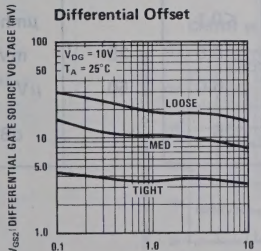
Noise Voltage vs Frequency



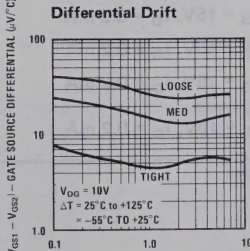
Capacitance vs Voltage



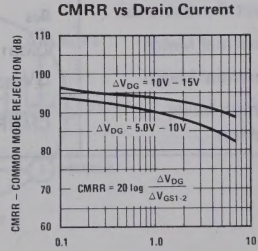
Differential Offset



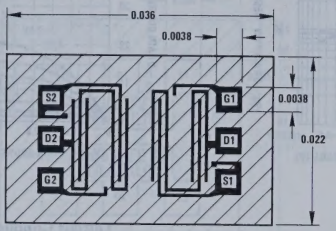
Differential Drift



CMRR vs Drain Current


ΔV_{DG} = 10V – 15V
ΔV_{DG} = 5.0V – 10V
CMRR = 20 log $\frac{\Delta V_{DG}}{\Delta V_{GS1-2}}$
CMRR – COMMON MODE REJECTION (dB)
I_D – DRAIN CURRENT (mA)

Process 94 N-Channel Junction FET



DESCRIPTION

Process 94 is a monolithic dual JFET. It is strictly intended for operational amplifier input buffer applications. Special processing results in extremely low input bias current and virtually unmeasureable offset current. It is important to note that the <5 pico ampere bias current is measured at 35 volts. Typical CMRR is 125 dB. Performance superior to electrometer tubes can be readily achieved with low offset voltage and almost zero long term drift.

PACKAGES:

TO-71 – NDF9406-10
TO-78 – NDF9401-5

PRINCIPAL DEVICE TYPES:

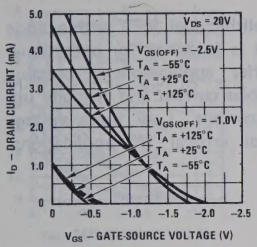
NDF9401-10 Series

OTHER DEVICE TYPES

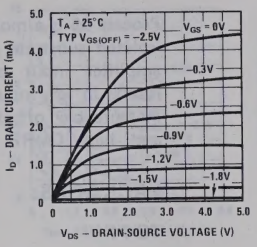
See pages 54 and 56.

CHARACTERISTIC	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Gate-Source Breakdown Voltage	BV_{GSS}	V_{DS} = 0V, I_G = −1 μA	−40	−70	−85	V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = 15V, V_{GS} = 0	0.5	3.0	10	mA
Forward Transconductance	g_{fs}	V_{DS} = 15V, V_{GS} = 0	1.5	3.5	7.0	mmho
Forward Transconductance	g_{fs}	V_{DG} = 15V, I_D = 0.2 mA	0.9	1.2	1.8	mmhos
Pinch Off Voltage	$V_{GS(OFF)}$	V_{DS} = 15V, I_D = 1 nA	−0.5	−2.0	−6.0	V
Gate Current	I_G	V_{DG} = 35V, I_D = 0.20 mA		1.0	15	pA
Feedback Capacitance	C_{rss}	V_{DS} = 15V, V_{GS} = 0, f = 1 MHz		0.01	0.02	pF
Input Capacitance	C_{iss}	V_{DS} = 15V, V_{GS} = 0, f = 1 MHz		4.0	5.0	pF
Noise Voltage	$\bar{e}_n$	V_{DG} = 15V, I_D = 0.2 mA, f = 10 Hz	5.0	12	50	$nV/\sqrt{Hz}$
Output Conductance	g_{os}	V_{DG} = 15V, I_D = 0.2 mA		<0.1		μmhos
Differential Match	$\lvert V_{GS1}-V_{GS2}\rvert$	V_{DG} = 15V, I_D = 0.2 mA		5.0	25	mV
Differential Match	ΔV_{GS1-2}	V_{DG} = 15V, I_D = 0.2 mA		6.0	50	μV/°C
Common Mode Rejection	CMRR	V_{DG} = 15V, I_D = 0.2 mA		125		dB

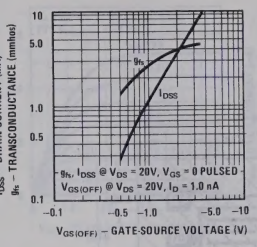
Transfer Characteristics



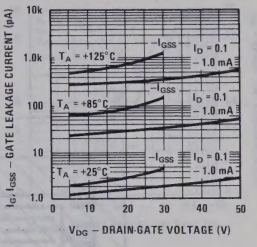
Common Drain-Source Characteristics



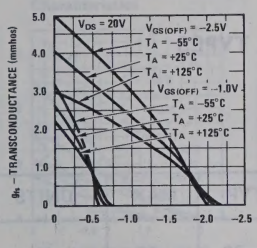
Parameter Interactions


g_{fs}
I_{DSS}
g_{fs}, I_{DSS} @ V_{DS} = 20V, V_{GS} = 0 PULSED
$V_{GS(OFF)}$ @ V_{DS} = 20V, I_D = 1.0 nA
I_{DSS} – DRAIN CURRENT (mA)
g_{fs} – TRANSCONDUCTANCE (mmhos)
$V_{GS(OFF)}$ – GATE-SOURCE VOLTAGE (V)

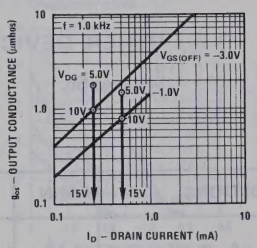
Leakage Current vs Voltage



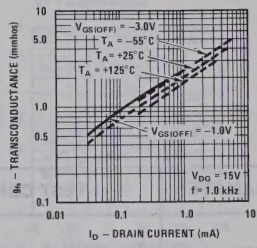
Transfer Characteristics



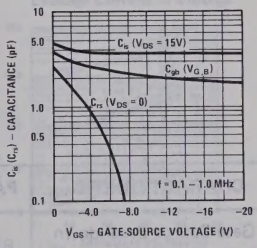
Output Conductance vs Drain Current



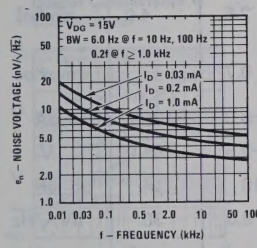
Transconductance vs Drain Current



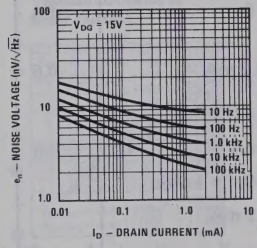
Capacitance vs Voltage



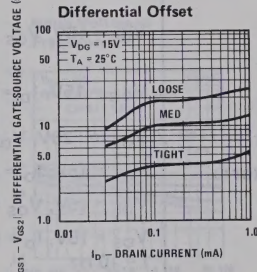
Noise Voltage vs Frequency



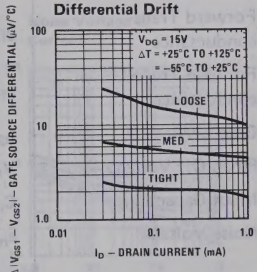
Noise Voltage vs Current



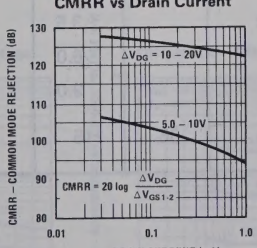
Differential Offset

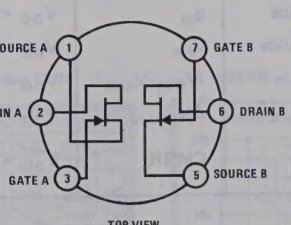


Differential Drift



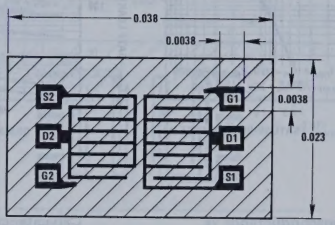
CMRR vs Drain Current





Note: With TO-78 package, lead 4 (case) may be used in two ways:
A. Connect to +V greater than plus signal voltage on either gate for minimal gate-to-gate coupling and differential charging effects.
B. Left floating when above not critical.

Process 95 N-Channel Junction FET



DESCRIPTION

Process 95 is a monolithic dual JFET with a diode isolated substrate. It is intended for operational amplifier input buffer applications. Processing results in low input bias current and virtually unmeasureable offset current. Low noise voltage and high CMRR for critical I/f applications.

PACKAGES:

TO-71

PRINCIPAL DEVICE TYPES:

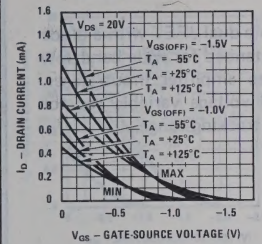
2N5515-24
2N6483-5

OTHER DEVICE TYPES

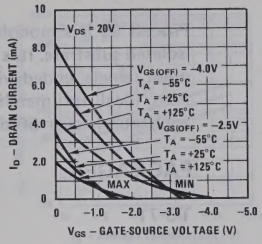
See page 55.

CHARACTERISTIC	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Gate-Source Breakdown Voltage	BV_{GSS}	V_{DS} = 0V, I_G = −1 μA	−40	−70	−85	V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = 15V, V_{GS} = 0	0.5	3.0	8.0	mA
Forward Transconductance	g_{fs}	V_{DS} = 15V, V_{GS} = 0	1.0	2.5	4.0	mmhos
Forward Transconductance	g_{fs}	V_{DG} = 15V, I_D = 0.2 mA	0.5	0.7		mmhos
Gate Leakage	I_{GSS}	V_{GS} = −20V, V_{DS} = 0		−5.0	−100	pA
Pinch Off Voltage	$V_{GS(OFF)}$	V_{DS} = 15V, I_D = 1 nA	−0.5	−2.5	−4.0	V
Input Capacitance	C_{iss}	V_{DS} = 15V, V_{GS} = 0, f = 1 MHz		10	14	pF
Noise Voltage	$\bar{e}_n$	V_{DS} = 15V, I_D = 0.2 mA, f = 10 Hz		8.0	30	$nV/\sqrt{Hz}$
Noise Voltage	$\bar{e}_n$	V_{DS} = 15V, I_D = 0.2 mA, f = 100 Hz		6.0	10	$nV/\sqrt{Hz}$
Output Conductance	g_{os}	V_{DG} = 15V, I_D = 0.2 mA		0.3	1.0	μmhos
Feedback Capacitance	C_{rss}	V_{DS} = 15V, V_{GS} = 0, f = 1 MHz		3.5	5.0	pF
Differential Match	$\lvert V_{GS1}-V_{GS2}\rvert$	V_{DG} = 20V, I_D = 0.2 mA		6.0	25	mV
Differential Match	ΔV_{GS1-2}	V_{DG} = 20V, I_D = 0.2 mA		9.0	60	μV/°C
Common Mode Rejection	CMRR	V_{DG} = 20V, I_D = 0.2 mA	86	115		dB

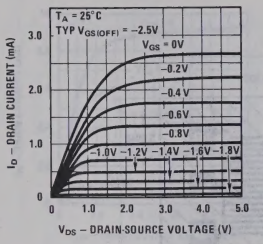
Transfer Characteristics



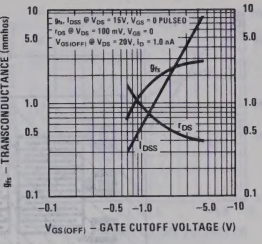
Transfer Characteristics



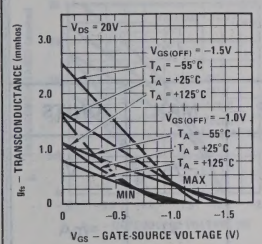
Common Drain-Source Characteristics



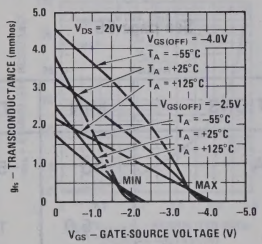
Parameter Interactions


g_{fs}, I_{DSS} @ V_{DS} = 15V, V_{GS} = 0 PULSED
r_{DS} @ V_{DS} = 100 mV, V_{GS} = 0
$V_{GS(OFF)}$ @ V_{DS} = 20V, I_D = 1.0 nA
g_{fs}
r_{DS}
I_{DSS}
I_{DSS} – DRAIN CURRENT (mA)
g_{fs} – TRANSCONDUCTANCE (mmhos)
r_{DS} – DRAIN "ON" RESISTANCE (kΩ)
$V_{GS(OFF)}$ – GATE CUTOFF VOLTAGE (V)

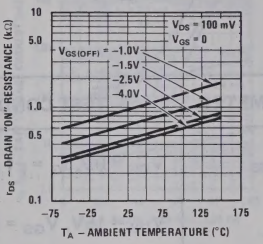
Transconductance Characteristics



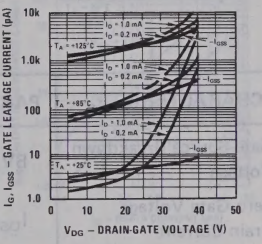
Transconductance Characteristics



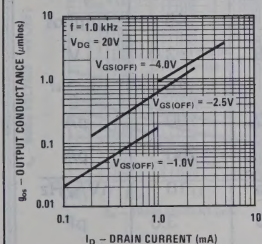
Channel Resistance vs Temperature



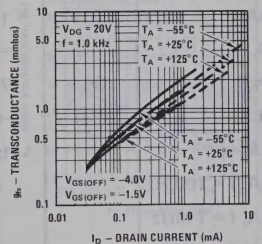
Leakage Current vs Voltage



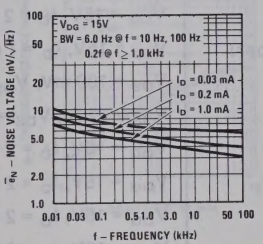
Output Conductance vs Drain Current



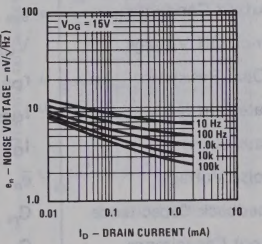
Transconductance vs Drain Current



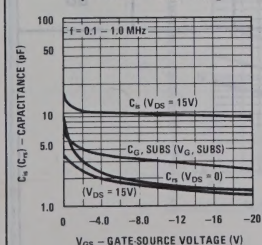
Noise Voltage vs Frequency



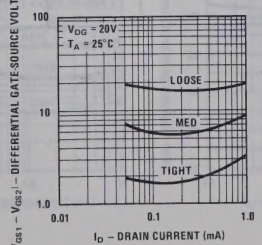
Noise Voltage vs Current



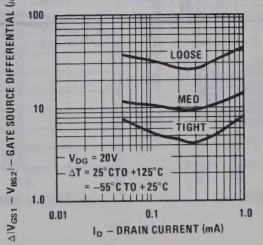
Capacitance vs Voltage



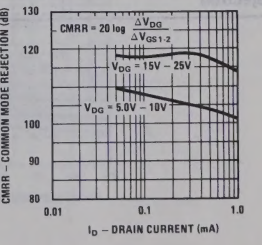
Differential Offset



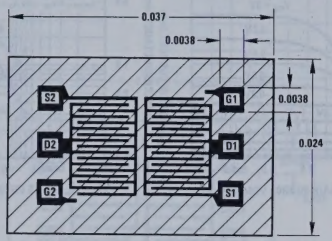
Differential Drift



CMRR vs Drain Current



Process 96 N-Channel Junction FET



DESCRIPTION

Process 96 is a monolithic dual JFET with a diode isolated substrate. It is intended for wide band, low noise, single ended video amplifier input stages. Also ideal for matched voltage variable resistor applications over 60 dB tracking range.

PACKAGES:

TO-71

PRINCIPAL DEVICE TYPES:

2N5564-6

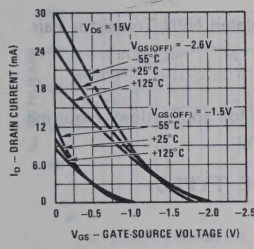
OTHER DEVICE TYPES

See page 55.

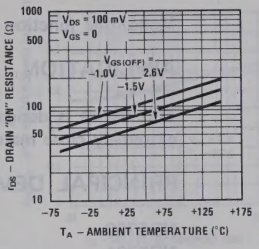
CHARACTERISTIC	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Gate-Source Breakdown Voltage	BV_{GSS}	V_{DS} = 0V, I_G = −1 μA	−40	−55	−75	V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = 15V, V_{GS} = 0	5.0	15	30	mA
Forward Trans-conductance	g_{fs}	V_{DS} = 15V, V_{GS} = 0	9.0	18	30	mmhos
Forward Trans-conductance	g_{fs}	V_{DG} = 15V, I_D = 2 mA	7.5	9.0		mmhos
Output Conductance	g_{os}	V_{DG} = 15V, I_D = 2 mA		15	45	μmhos
Pinch Off Voltage	$V_{GS(OFF)}$	V_{DS} = 15V, I_D = 1 nA		−1.8	−3.0	V
"ON" Resistance	r_{DS}	V_{DS} = 100 mV, V_{GS} = 0	35	70	120	Ω
Gate Current	I_{GSS}	V_{GS} = −20V, V_{DS} = 0		−8.0	−100	pA
Gate Current	I_G	V_{DG} = 15V, I_D = 2 mA		15	200	pA
Noise Voltage	$\bar{e}_n$	V_{DG} = 15V, I_D = 2 mA, f = 100 Hz		4.5	10	$nV/\sqrt{Hz}$
Feedback Capacitance	C_{rs}	V_{DG} = 15V, I_D = 2 mA, f = 1 MHz		2.5	3.0	pF
Input Capacitance	C_{is}	V_{DG} = 15V, I_D = 2 mA, f = 1 MHz		10	12	pF
Differential Voltage	$\lvert V_{GS1}-V_{GS2}\rvert$	V_{DG} = 15V, I_D = 2 mA		8.0	25	mV
Differential Voltage	ΔV_{GS}	V_{DG} = 15V, I_D = 2 mA		9.0	50	μV/°C
Common Mode Rejection	CMRR	V_{DG} = 15V, I_D = 2 mA	76	95		dB

Process 96

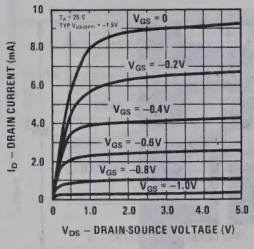
Transfer Characteristics



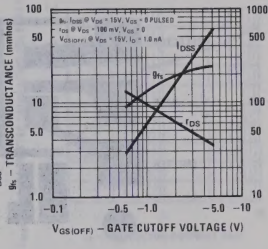
Channel Resistance vs Temperature



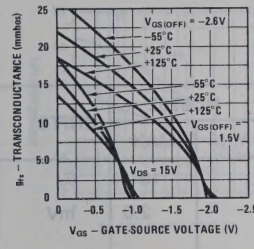
Common Drain-Source Characteristics



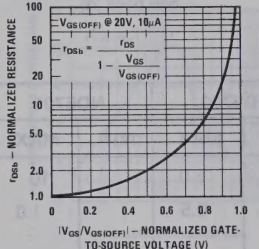
Parameter Interactions



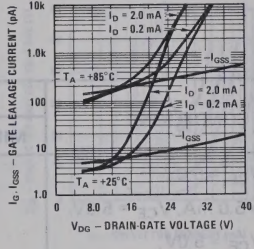
Transfer Characteristics



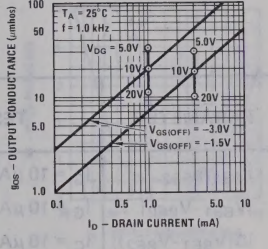
Normalized Drain Resistance vs Bias Voltage


$V_{GS(OFF)}$ @ 20V, 10μA
$r_{DSb} = \frac{r_{DS}}{1 - \frac{V_{GS}}{V_{GS(OFF)}}}$
r_{DSb} – NORMALIZED RESISTANCE
$|V_{GS}/V_{GS(OFF)}|$ – NORMALIZED GATE-TO-SOURCE VOLTAGE (V)

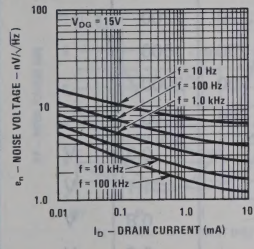
Leakage Current vs Voltage



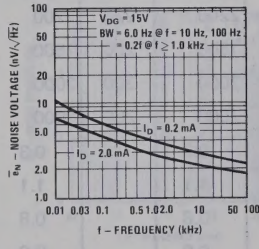
Output Conductance vs Drain Current



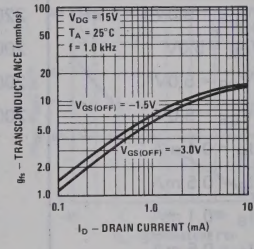
Noise Voltage vs Current



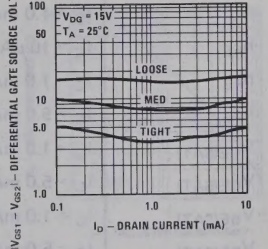
Noise Voltage vs Frequency



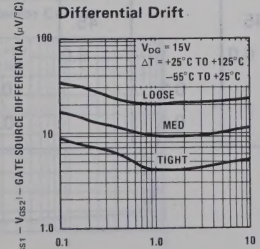
Transconductance vs Drain Current



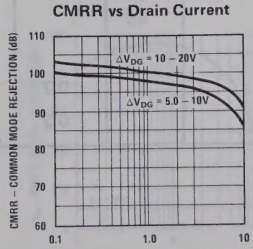
Differential Offset



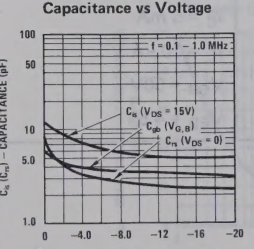
Differential Drift



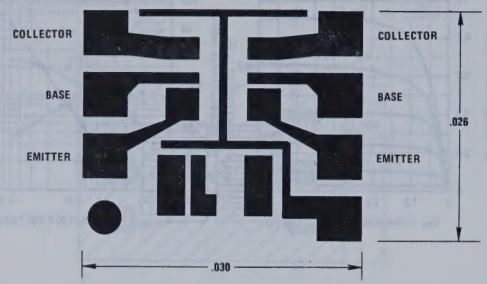
CMRR vs Drain Current



Capacitance vs Voltage



Process 570 NPN Monolithic Dual



NPN TRANISTOR PAIR

DESCRIPTION

Monolithic junction isolated NPN Transistor Pair.

APPLICATION

This device is designed for applications requiring extremely close matching.

PRINCIPAL DEVICE TYPES:

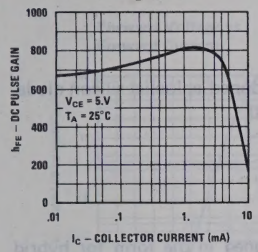
ND5700
ND5701
ND5702

OTHER DEVICE TYPES

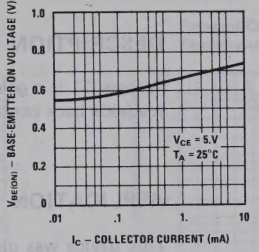
See page 26.

PARAMETER	TEST CONDITIONS	ND5700		ND5701		ND5702		UNITS
		MIN	MAX	MIN	MAX	MIN	MAX	
h_{FE1}/h_{FE2}	I_C = 10 μA, V_{CE} = 5.0V		5.0		10		10	%
$\|V_{BE1}-V_{BE2}\|$	I_C = 10 μA to 5.0 mA, V_{CE} = 5.0V		0.5		1.0		2.0	mV
$\|\Delta(V_{BE1}-V_{BE2})\|$	I_C = 10 μA, V_{CE} = 5.0V, T_A = -55°C to +125°C		2.0		5.0		10	μV/°C
C_{ob}	I_E = 0, V_{CB} = 5.0V		3.0		3.0		3.0	pF
C_{ib}	I_C = 0, V_{EB} = 0.5V		3.0		3.0		3.0	pF
h_{fe}	I_C = 1.0 mA, V_{CE} = 5.0V, f = 1 kHz	220	2200	220	2200	220	2200	
h_{FE}	I_C = 10 μA, V_{CE} = 5.0V	200	1500	200	1500	200	1500	
h_{FE}	I_C = 1.0 mA, V_{CE} = 5.0V	200	2000	200	2000	200	2000	
h_{FE}	I_C = 5.0 mA, V_{CE} = 5.0V	200	2000	200	2000	200	2000	
$V_{CE(SAT)}$	I_C = 1.0 mA, I_B = 0.1 mA		0.3		0.3		0.3	V
$V_{CE(SAT)}$	I_C = 5.0 mA, I_B = 0.5 mA		1.1		1.1		1.1	V
$V_{BE(SAT)}$	I_C = 1.0 mA, I_B = 0.1 mA		0.8		0.8		0.8	V
$V_{BE(SAT)}$	I_C = 5.0 mA, I_B = 0.5 mA		0.9		0.9		0.9	V
$V_{BE(ON)}$	I_C = 10 μA, V_{CE} = 5.0V		0.7		0.7		0.7	V
BV_{CBO}	I_C = 10 μA	45		45		45		V
BV_{CEO}	I_C = 5 mA	45		45		45		V
BV_{EBO}	I_E = 10 μA	6.0		6.0		6.0		V
I_{CBO}	V_{CB} = 50V		0.2		0.2		0.2	nA
I_{EBO}	V_{EB} = 4.5V		0.2		0.2		0.2	nA

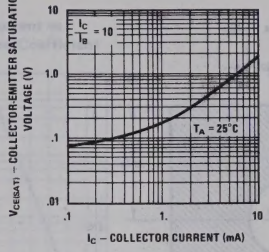
DC Pulse Current Gain vs Collector Current



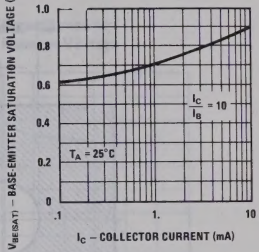
Base-Emitter On Voltage vs Collector Current



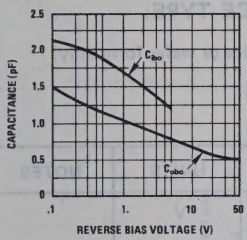
Collector-Emitter Saturation Voltage vs Collector Current



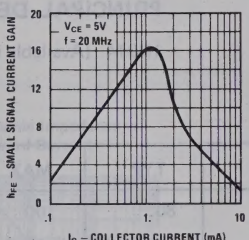
Base-Emitter Saturation Voltage vs Collector Current



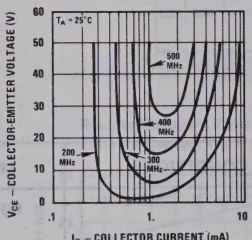
Input and Output Capacitance vs Reverse Bias Voltage



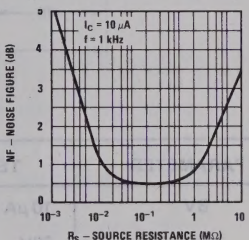
Small Signal Current Gain vs Collector Current



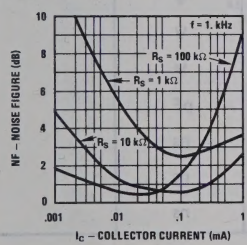
Contours of Constant Gain Bandwidth Product



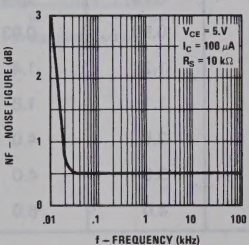
Noise Figure vs Source Resistance



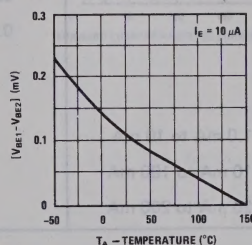
Noise Figure vs Collector Current



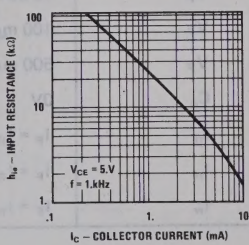
Noise Figure vs Frequency



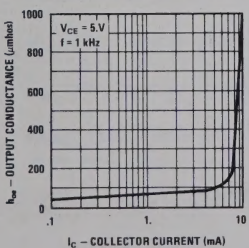
$[V_{BE1} - V_{BE2}]$ vs Temperature



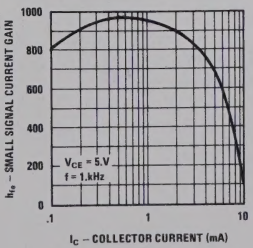
Small Signal Input Resistance vs Collector Current



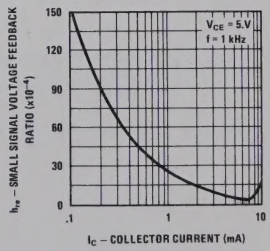
Small Signal Output Conductance vs Collector Current



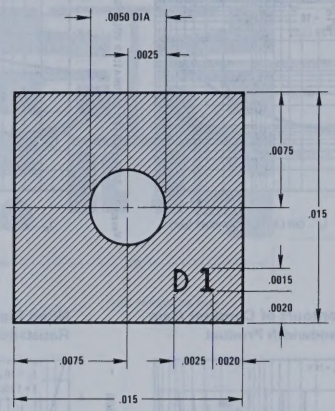
Small Signal Current Gain vs Collector Current



Small Signal Voltage Feedback Ratio vs Collector Current



Process D1 High Speed Diode



DESCRIPTION

Process D1 is a gold doped epitaxial silicon diode. (cathode back contact)

APPLICATION

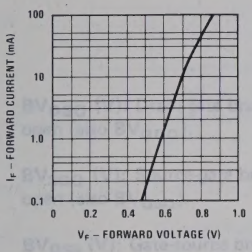
This device was designed in die form for hybrid circuit applications requiring a high speed diode having controlled forward characteristics.

PRINCIPAL DEVICE TYPE:

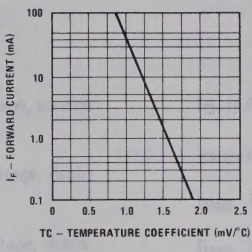
1N914 (Available in dice or wafer form only)

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
BV	10 μA	60	80	100	V	
I_R	50V		30	100	nA	
V_F	100 μA	0.46	0.48	0.49	V	
V_F	1.0 mA	0.56	0.58	0.62	V	
V_F	10 mA	0.66	0.70	0.74	V	
V_F	100 mA	0.82	0.90	0.93	V	
V_F	500 mA		1.2	1.4	V	
C_o	0V		1.1	1.8	pF	
t_{rr}	$I_F = I_R$ = 1.0 mA to 10 mA		2.5	4.0	ns	
t_{rr}	$I_F = I_R$ = 10 mA to 100 mA		3.0	4.0	ns	
t_{rr}	$I_F = I_R$ = 20 mA to 200 mA		4.0	6.0	ns	

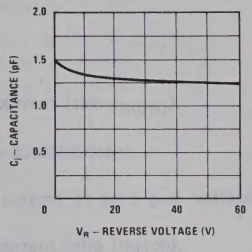
Forward Voltage vs Forward Current



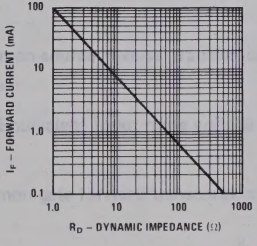
Forward Current vs Temperature Coefficient



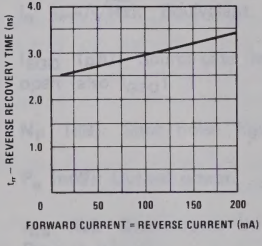
Capacitance vs Reverse Voltage



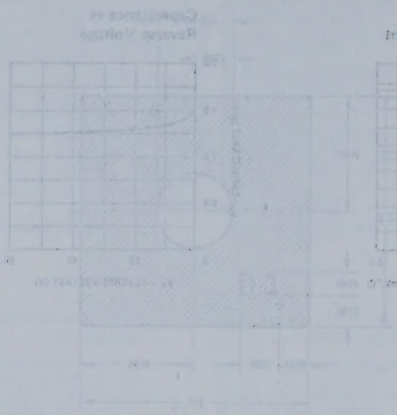
Dynamic Impedance vs Forward Current

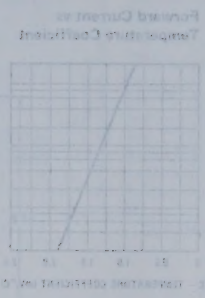


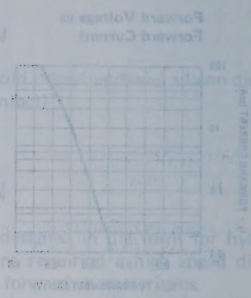
Reverse Recovery Time vs Forward Current ($I_F = I_R$)



Process D1 High Speed Diode







DESCRIPTION

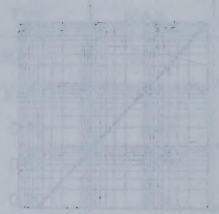
Process D1 is a gold diffused epitaxial silicon diode, cathode back contact.

APPLICATION

This device was designed in the form for hybrid circuit applications requiring a high speed diode driving controlled forward and reverse currents.

PRINCIPAL DEVICE TYPE:

1N914 (Available in dice or wafer form only)



PARAMETER	TEST CONDITIONS	MIN	MAX	UNITS	NOTES
BV	10 µA	60		V	
I_R	50V			nA	
V_F	100 µA	0.48		V	
V_F	1.0 mA	0.56		V	
V_F	10 mA	0.65		V	
V_F	100 mA	0.82		V	
V_F	500 mA		1.2	V	
C_T	0V		1.1	pF	
t_{rr}	$I_F = I_R$ = 1.0 mA to 10 µA		2.5	nS	
t_{rr}	$I_F = I_R$ = 10 mA to 100 mA		3.0	nS	
t_{rr}	$I_F = I_R$ = 20 mA to 200 mA		4.0	nS	

JFET Glossary of Terms and Symbols

BV_{DGO} (V): Drain-gate breakdown voltage, source open (also BV_{GDO}).

BV_{SGO} (V): Source-gate breakdown voltage, drain open (also BV_{GSO}).

BV_{GSS} (V): Gate-source breakdown voltage, drain-source shorted (also $V_{(BR)GSS}$, BV).

C_{is} (pF): Common-source input capacitance (also C_{iss}, C_{dg}).

CMRR (dB): Common mode rejection ratio (also CMR).

C_{os} (pF): Common-source output capacitance (also C_{oss}).

C_{rs} (pF): Common-source reverse transfer capacitance (also C_{rss}).

$\bar{e}_n$ ($nV/\sqrt{Hz}$): Equivalent input noise voltage (also e_n, V_n).

g_{fg} (m℧): Common-gate forward transconductance ($+g_{fg}$, $-b_{fg}$).

g_{fs} (m℧): Common-source forward transconductance (also Y_{fs}, $R_e|Y_{fs}|$, g_m, $+g_{fs}$, $-b_{fs}$).

g_{fs} ½(%): Transconductance ratio (match).

g_{iss} (μ℧): Common-source input conductance (b_{iss}, g_{iss}).

g_{oss} (μ℧): Common-source output conductance (b_{oss}, g_{oss}).

$g_{oss1\text{-}2}$ (μ℧): Output conductance differential (match – also $g_{os1\text{-}2}$).

G_{pg} (dB): Common-gate power gain.

G_{ps} (dB): Common-source power gain.

I_{DGO} (pA): Drain-gate leakage current, source open (also I_{GDO}).

I_D (pA): Drain on current (also $I_{D(ON)}$).

$I_{D(OFF)}$ (pA): Drain cutoff current.

I_{DSS} (mA): Drain current at zero gate voltage.

I_{DSS} ½(%): Drain current ratio (match).

I_G (pA): Gate leakage current under operating conditions.

$I_{G1\text{-}2}$ (pA): Gate differential current (match).

I_{GSS} (pA): Gate-source reverse current, source-drain shorted.

i_n ($pA/\sqrt{Hz}$): Equivalent input noise current.

I_{SGO} (pA): Source-gate leakage current, drain open (also I_{GSO}).

N_F (dB): Spot noise figure, or noise factor.

P_o (mW): Output power.

r_{DS} (Ω): Drain-source on resistance (also r_{ds}, R_{DS}, $r_{DS(ON)}$).

t_{off} (ns): Turn-off time (also $t_{d(off)}$).

t_{on} (ns): Turn-on time (also $t_{d(on)}$).

$V_{DS(ON)}$ (mV): Drain-source on voltage.

V_{GS} (V): Operating gate-source voltage, (also V_G).

$V_{GS(F)}$ (V): Gate-source forward voltage.

$V_{GS1\text{-}2}$ (mV): Gate-source differential voltage (also $|V_{GS1}\text{-}V_{GS2}|$, V_{os}).

$\Delta V_{GS1\text{-}2}$ ($\mu V/°C$): Gate-source differential voltage vs temperature (also $\Delta|V_{GS1}\text{-}V_{GS2}|$, ΔV_{os}).

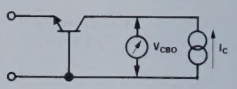
V_p (V): Gate-source cutoff (pinch-off) voltage (also $V_{GS(OFF)}$).

Glossary of Symbols

DC PARAMETERS

BV_{CBO} — Collector-Base Breakdown Voltage with Emitter Open-Circuited

The breakdown voltage of the collector-base junction, measured at a specified current, with the emitter open-circuited.



BV_{CEO} — Collector-Emitter Breakdown Voltage with the Base Open-Circuited

The collector-emitter breakdown voltage, measured at a specified collector current, with the base open-circuited.

BV_{CER} — Collector-Emitter Breakdown Voltage with Resistance between Emitter and Base

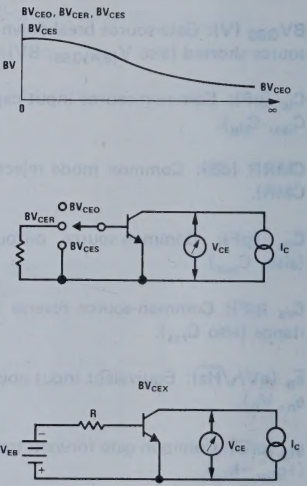
The collector-emitter breakdown voltage measured at a specified current with a specified resistance R connected between the base and the emitter.

BV_{CES} — Collector-Emitter Breakdown Voltage with Base Shorted to Emitter

The collector-emitter breakdown, measured at a specified current, with the base shorted to the emitter.

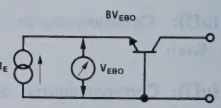
BV_{CEX} — Collector-Emitter Breakdown Voltage at a Specified Condition

The collector-emitter breakdown voltage measured at a specified current with the base-emitter junction forward or reverse biased by a specified voltage or current.



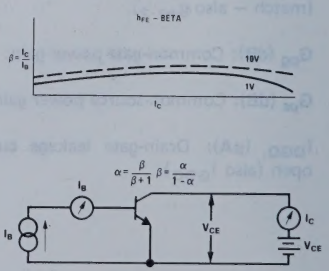
BV_{EBO} — Emitter-Base Breakdown Voltage with Collector Open-Circuited

The emitter-base breakdown voltage, measured at a specified current, with the collector open-circuited.



h_{FE} — Common-Emitter DC Current Gain

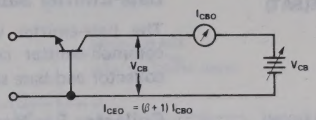
The ratio of DC collector current to DC base current measured at a specified collector-emitter voltage and a specified collector current.



I_{CBO}

Inverse Collector-Base Current

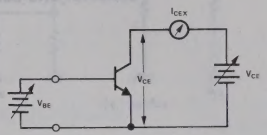
The collector-base current with the junction reverse biased by a specified voltage, with the emitter open-circuited.



I_{CEX}

Inverse Collector-Emitter Current at a Specified Condition

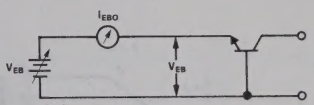
The collector-emitter current measured at a specified collector-emitter voltage with the base forward or reverse biased by a specified voltage or current.



I_{EBO}

Inverse Emitter-Base Current

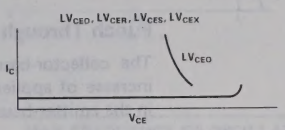
The emitter-base current with the junction reverse biased by a specified voltage with the collector open-circuited.

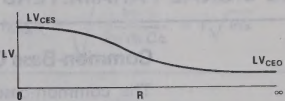


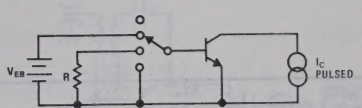
LV_{CEO},
LV_{CER},
LV_{CES},
LV_{CEX}, or,
V_{CEO}(sust)
V_{CER}(sust)
V_{CES}(sust)
V_{CEX}(sust)

Pulsed Limiting Breakdown Voltages

These are similar to the corresponding, above defined, BV parameters but are measured at a specified high current point where collector-emitter voltage is lowest. The duration of the pulse and its duty cycle must be specified. The letter L indicates LIMITING Value and is measured outside the negative resistance zone of the reverse characteristic.



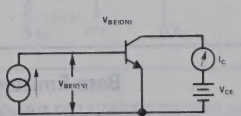


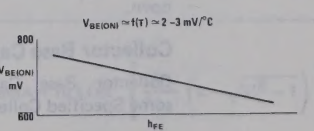


$V_{BE\ (ON)}$

Unsaturated Base-Emitter Voltage

The base-emitter voltage measured in the common-emitter connection at a specified collector to emitter voltage and specified collector current.



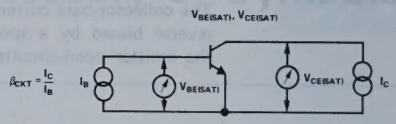


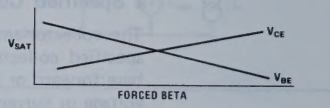
$V_{BE(SAT)}$ **Base-Emitter Saturation Voltage**

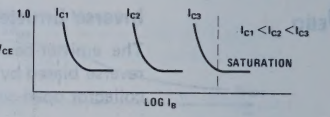
The base-emitter voltage measured in the common-emitter connection at a specified collector and base saturation currents.

$V_{CE(SAT)}$ **Collector-Emitter Saturation Voltage**

The collector-emitter voltage measured in the common-emitter connection at specified collector and base saturation currents.







V_{RT} **Reach Through Voltage**

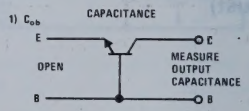
V_{PT} **Punch Through Voltage**

The collector-base voltage above which an increase of applied voltage can be measured in the emitter-base open circuit.

SMALL SIGNAL PARAMETERS

C_{ob} **Common-Base Output Capacitance**

The common-base output capacitance with input ac open.



C_{re} **Common Emitter Reverse Transfer Capacitance**

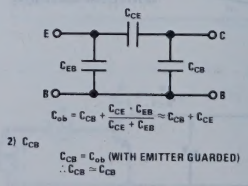
This parameter is the imaginary part of y_{re}. When $I_C = 0$, C_{re} is identical to C_{CB}.

C_{TE} **Base-Emitter Capacitance**

The capacity of the base-emitter junction at a specified inverse voltage with the collector open.

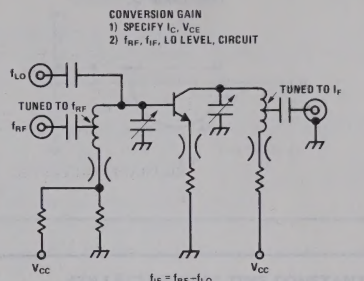
C_{CB} **Collector Base Capacitance**

Collector Base Capacitance measured at some Specified Collector Base Voltage.



CG_e, CG_b — Conversion Gain, Common-Emitter or Common-Base

The ratio of the output power of a mixer, at one specified frequency, to its input power, at another specified frequency. This parameter is a function of oscillator injection voltage and the mixer operating point.



$f_{\alpha b}$, $f_{h_{fb}}$ — Common-Base Cut Off Frequency

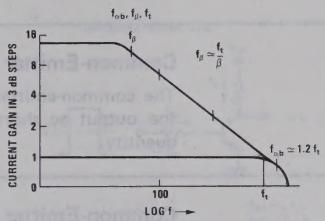
The frequency at which the h_{fb} (α) is reduced to 0.707 of its low frequency value.

f_β, $f_{h_{fe}}$ — Common-Emitter Cut Off Frequency

The frequency at which the h_{fe} (β) is reduced to 0.707 of its low frequency value.

Gain Band-Width Product

The common-emitter current gain band-width product in the frequency range where the current gain is falling at approximately 6 db/octave.



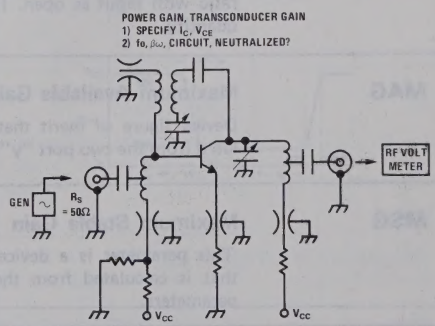
f_t — Maximum Frequency of Oscillation

This parameter is a device figure of merit that is calculated from ft and rb'Cc.

f_{MAX} = MAX FREQUENCY OF OSCILLATION / FREQUENCY AT WHICH MAG = 1

$$f_{MAX} = \sqrt{\frac{f_T}{8\pi\, rb\, Cc}} = f\sqrt{PG}$$

G_e — Common-Emitter Power Gain



C_{TE} — Common Emitter Transducer Gain

A test fixture must be specified.

$$G_{TE} = \frac{\text{POWER DELIVERED TO THE LOAD}}{\text{POWER AVAILABLE FROM THE SOURCE}}$$

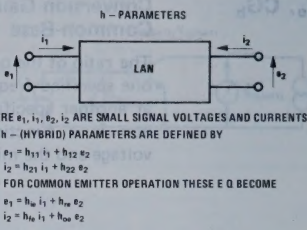
GMA — Stability Limited Gain or Gain Maximum Available

This parameter is a device figure of merit and must be calculated from the two port "y" parameters.

$$GMA = 10 \log \left[\frac{|Y_{fe}|}{|Y_{re}|} \left(K - \sqrt{K^2 - 1} \right) \right]$$

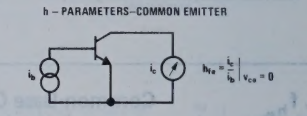
NOT DEFINED FOR $K < 1$

h Parameters


h – PARAMETERS
LAN
WHERE e_1, i_1, e_2, i_2 ARE SMALL SIGNAL VOLTAGES AND CURRENTS
THE h – (HYBRID) PARAMETERS ARE DEFINED BY
$e_1 = h_{11} i_1 + h_{12} e_2$
$i_2 = h_{21} i_1 + h_{22} e_2$
AND FOR COMMON EMITTER OPERATION THESE E Q BECOME
$e_1 = h_{ie} i_1 + h_{re} e_2$
$i_2 = h_{fe} i_1 + h_{oe} e_2$

h_{fe} Common-Emitter Current Gain

The common-emitter forward current transfer ratio with output ac shorted. This is a complex quantity.

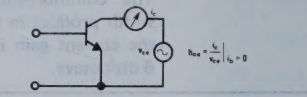


h_{ie} Common-Emitter Input Impedance

The common-emitter input impedance with the output ac shorted. This is a complex quantity.

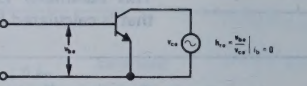
h_{oe} Common-Emitter Output Admittance

The common-emitter output admittance with the input ac open. This is a complex quantity.



h_{re} Common-Emitter Reverse Voltage Transfer Ratio

The common-emitter reverse voltage transfer ratio with input ac open. This is a complex quantity.



MAG Maximum Available Gain

Device figure of merit that must be calculated from the two port "y" parameters.

$$MAG = 10 \log \frac{|Y_{21}|^2}{4 \, Re\,(Y_{11}) \, RE\,(Y_{22})}$$

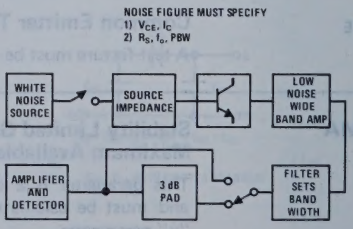
MSG Maximum Stable Gain

This parameter is a device figure of merit that is calculated from the two port "y" parameters.

$$MSG = 10 \log \frac{|Y_{fe}|}{|Y_{re}|}$$

NF Noise Figure

Noise figure = $10 \log_{10} F$, where F is the ratio of total output noise power to the output power due solely to the thermal noise of the source impedance.

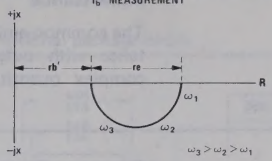


r_{bb}', r_b'

Base << Spreading >> Resistance

Equivalent to the real part of h_{ie} at some specified very high frequency.

r_b' MEASUREMENT



rb'Cc

Collector Base Time Constant

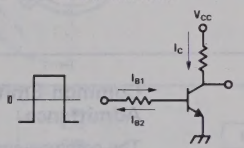
This parameter is a device figure of merit and is measured in a specified test circuit.

$r_b' C_c$ = COLLECTOR BASE TIME CONSTANT
SPECIFY – I_C, V_{CE}, FREQUENCY

Common-Emitter Switching Parameters

In the following, drive circuit conditions and collector circuit conditions must be specified. The transition times of the input must be negligible compared to the measured times.

SWITCHING PARAMETERS



$T_{ON} = t_d + t_r$
$T_{OFF} = t_s + t_f$

t_d

Delay Time

The time interval during turn-on from the point when the input pulse at the base reaches 10% of its full amplitude to the point when the collector pulse changes from 0 to 10% of its maximum amplitude.

t_r

Rise Time

The time interval during turn-on in which the collector pulse changes from 10% to 90% of its maximum amplitude.

t_s

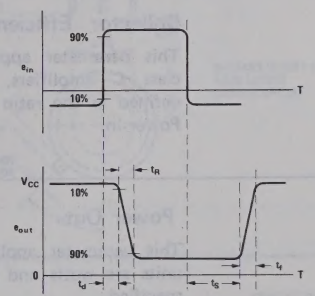
Storage Time

The time interval during turn-off from the point when the turn-off pulse at the base changes from 100% to 90% of its full amplitude to the time when the collector current has changed from 100% to 90% of its maximum amplitude.

t_f

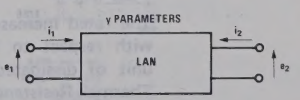
Fall Time

The time interval during turn-off in which the collector pulse decreases from 90% to 10% of its maximum amplitude.



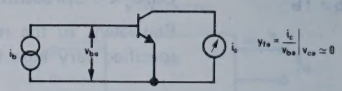
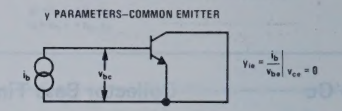
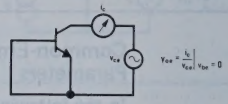
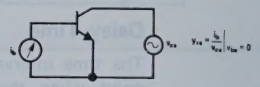
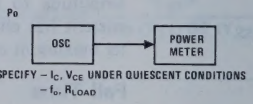
y Parameters

y PARAMETERS



y PARAMETERS ARE DEFINED BY
$i_1 = y_{11} e_1 + y_{12} e_2$
$i_2 = y_{21} e_1 + y_{22} e_2$

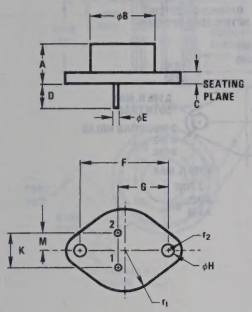
OR IN COMMON EMITTER NOTATION
$i_1 = y_{ie} e_1 + y_{re} e_2$
$i_2 = y_{fe} e_1 + y_{oe} e_2$

Y_{fe}	**Common-Emitter Forward Transfer Admittance** The common-emitter forward transfer admittance with output ac shorted. This is a complex quantity ($g_{fe} + jb_{fe}$).	
Y_{ie}	**Common-Emitter Input Admittance** The common-emitter input admittance with output ac shorted. This is a complex quantity ($g_{ie} + b_{ie}$).	
Y_{oe}	**Common-Emitter Output Admittance** The common-emitter output admittance with input ac open. This is a complex quantity ($g_{oe} + jb_{oe}$).	
Y_{re}	**Common-Emitter Reverse Transfer Admittance** The common-emitter reverse transfer admittance with input ac shorted. This is a complex quantity ($g_{re} + jb_{re}$).	
LARGE SIGNAL PARAMETERS		
η	**Collector Efficiency** This parameter applies to oscillators and class C amplifiers, predominantly. It is defined as the ratio of RF Power Out/DC Power In.	η – COLLECTOR EFFICIENCY $\eta = \frac{P_O\ (RF)}{P_{IN(DC)}} = \frac{vi}{I_C \times V_{CE}}$
P_o	**Power Out** This parameter applies to oscillators. The units are watts and a test circuit must be specified.	
THERMAL PARAMETERS		
R_{TH}	**Internal Junction-to Case Thermal Resistance** The rated increase of junction temperature with respect to the case temperature per unit of dissipated power. It is also called Thermal Resistance with infinite heat sink.	
θ_{JC}	**Junction-to Case Thermal Rating**	
θ_{JA}	**Junction-to Ambient Thermal Rating**	

Package Outlines

NOTE: All dimensions are in inches. Numbers in parentheses are NS internal package codes.

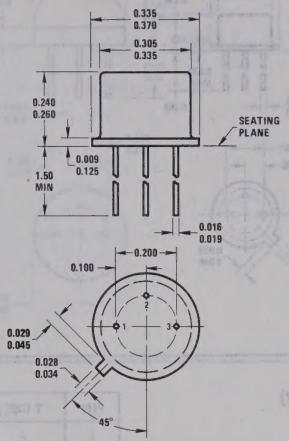
TO-3 (98)



Terminal Connections
Pin 1 – Ground
Pin 2 – Output
Case – Input

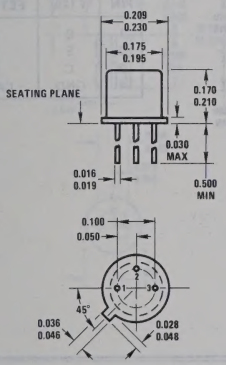
SYMBOL	INCHES	
	MIN	MAX
A	.250	.450
ϕE	.038	.043
ϕB		.875
K	.420	.440
M	.205	.225
C		.135
D	.312	
ϕH	.151	.161
F	1.177	1.197
r_1		.525
r_2		.188
G	.655	.675

TO-5 (04)



PIN	T
1	E
2	B
3	C

TO-18 (02, 11, 19)

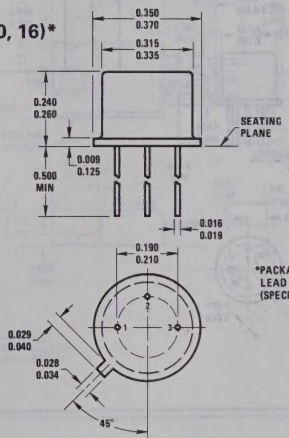


PIN	T (02), (19)
1	E
2	B
3	C

PIN	FET N (02)
1	S
2	D
3	G

PIN	FET P (11)
1	S
2	G
3	D

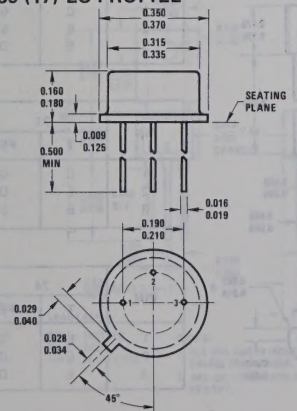
TO-39 (10, 16)*



*PACKAGE 16 HAS 1 1/2" LEAD LENGTH (SPECIAL ORDER).

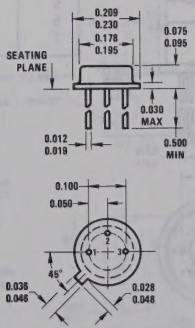
PIN	T
1	E
2	B
3	C

TO-39 (17) LO-PROFILE



PIN	T
1	E
2	B
3	C

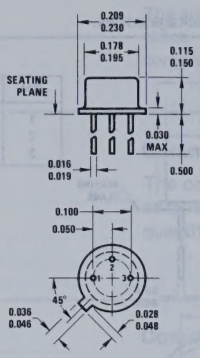
TO-46 (06)



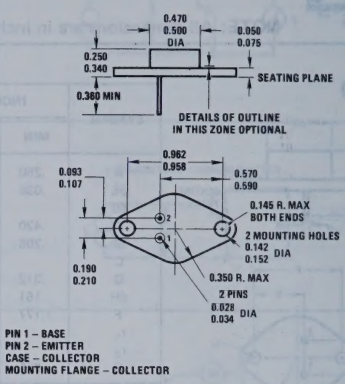
PIN	T
1	E
2	B
3	C

TO-52 (07, 18)

PIN	T (18)	FET (07)
1	E	S
2	B	D
3	C	G



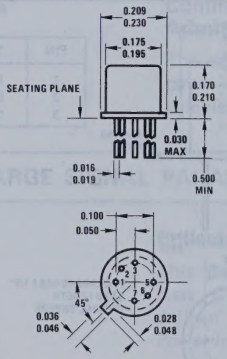
TO-66 (99)



PIN 1 – BASE
PIN 2 – EMITTER
CASE – COLLECTOR
MOUNTING FLANGE – COLLECTOR

TO-71 (08, 12)

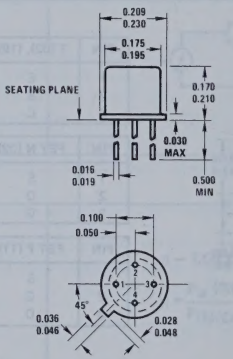
PIN	T (08)	FET (12)
1	E	S1
2	B	D1
3	C	G1
5	E	S2
6	B	D2
7	C	G2



TO-72 (23, 25, 28)

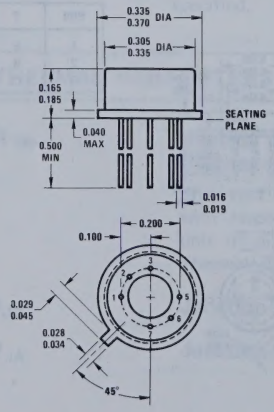
PIN	T (25)	FET N (25)
1	E	S
2	B	D
3	C	G
4	GND	CASE

PIN	T (28)	FET P (23)
1	B	S
2	E	G
3	C	D
4	GND	CASE



TO-78 (24, 27)

PIN	T (27)	FET (24)
1	C	S1
2	B	D1
3	E	G1
5	E	S2
6	B	D2
7	C	G2

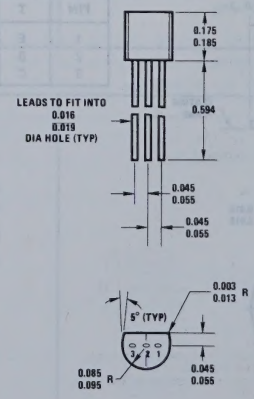


TO-92 (71, 72, 74)

PIN	72 (Std)	
	T	FET
1	C	G
2	B	S
3	E	D

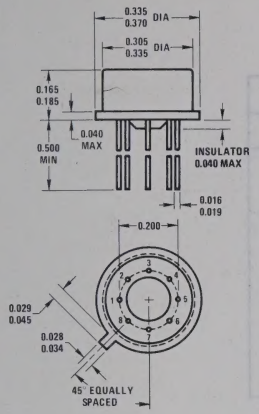
PIN	71	
	T	FET
1	C	G
2	E	D
3	B	S

PIN	74	
	T	FET
1	B	S
2	C	G
3	E	D



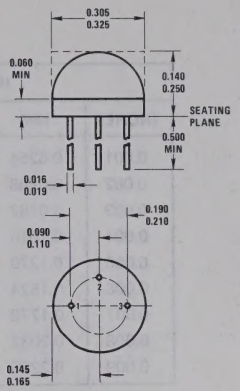
TO-99 (22)

PIN	FET
1	S
2	D
3	G
4	SUB
5	S
6	D
7	G
8	NC



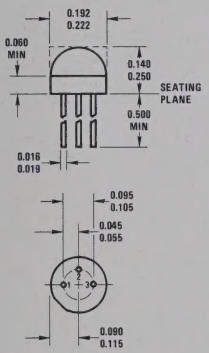
TO-105 (34)

PIN	T
1	E
2	B
3	C

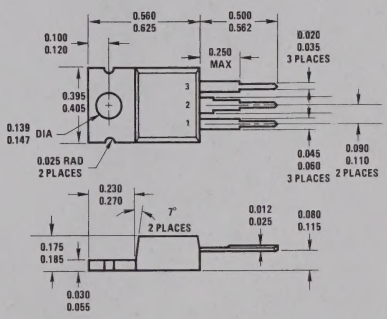


TO-106 (33)

PIN	T	FET
1	E	S
2	B	D
3	C	G

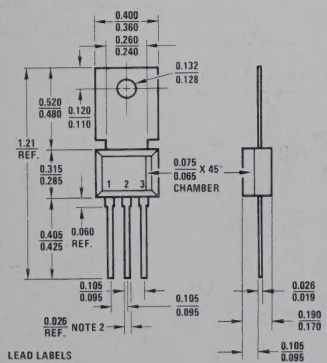


TO-220 (37)



PIN 1 – BASE
PIN 2 – COLLECTOR
PIN 3 – EMITTER

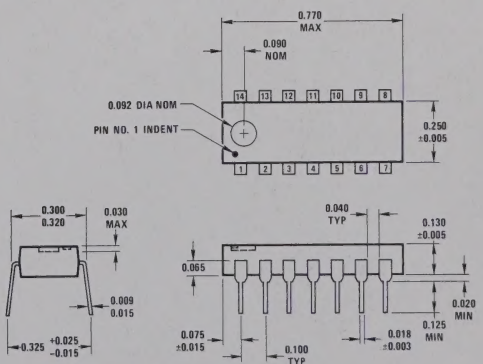
TO-202 (35)



LEAD LABELS
PIN 1 – EMITTER
PIN 2 – BASE
PIN 3 – COLLECTOR

NOTES:
1. ALL DIM. ARE IN INCHES AND ARE REF. UNLESS TOLERANCED.
2. .043-.057 LEAD WIDTH WITHIN 0.100 OF BODY.

MOLDED DUAL-IN-LINE PACKAGE (N) (39)



CONVERSION TABLE

INCHES TO MILLIMETERS					
INCHES	MM	INCHES	MM	INCHES	MM
0.001	0.0254	0.010	0.254	0.100	2.54
0.002	0.0508	0.020	0.508	0.200	5.08
0.003	0.0762	0.030	0.762	0.300	7.62
0.004	0.1016	0.040	1.016	0.400	10.16
0.005	0.1270	0.050	1.270	0.500	12.70
0.006	0.1524	0.060	1.524	0.600	15.24
0.007	0.1778	0.070	1.778	0.700	17.78
0.008	0.2032	0.080	2.032	0.800	20.32
0.009	0.2286	0.090	2.286	0.900	22.86

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